THE

DUBLIN DISSECTOR,

OR

MANUAL OF ANATOMY:

COMPRISING

A CONCISE DESCRIPTION

OF

THE BONES, MUSCLES, VESSELS, NERVES AND VISCERA,

ALSO

THE RELATIVE ANATOMY OF THE DIFFERENT REGIONS

OF THE HUMAN BODY;

FOR THE

Use of Students in the Dissecting Room.

BY A MEMBER
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THE

DUBLIN DISSECTOR.

CHAPTER I.

DISSECTION OF THE EXTERNAL PARTS OF THE HEAD AND FACE.

§ 1.—*External Parts of the Head.*

The integuments covering the cranium are firm and dense, although when felt they give the sensation of being thin: the cuticle is delicate, but the cutis is very thick; the subjacent cellular membrane contains granulated fat, and the bulbs of the hairs, which afterwards perforate the skin in an oblique direction. The cellular tissue here has partly a ligamentous structure, and adheres so intimately to the subjacent muscular and tendinous expansion, that the inexperienced student may find some difficulty in exposing the surface of the latter. Make an incision through the integuments along the median line, from the tuberosity of the occipital bone, as far forwards as the lower part of the forehead: from each extremity of this, make a transverse incision about three inches long; let the posterior one be parallel to the superior transverse ridge of the occipital bone, and the anterior one parallel, and about half an inch superior to the eyebrow; cautiously dissect off the integuments from the subjacent muscular and tendinous expansion, which is the occipito-frontalis. This muscle, like most of the superficial muscles of the face, is closely attached to the skin, which circumstance, added to the paleness and smallness of their fibres, renders their dissection somewhat difficult and tedious. Most of the superficial muscles of the head and face, during life, assist some of the organs of sense, and contribute to produce certain changes in the countenance, indicative of character or passion.

The superficial muscles of the head are divided into those of the cranium and face. Those of the cranium are the occipito-frontalis, and the three common muscles of the ear.

Occipito-Frontalis is the only muscle which properly belongs to the scalp; it is thin and broad, fleshy at each extremity, aponeurotic in the centre. It *arises* by tendinous and fleshy fibres on each side of the middle line, from the two external thirds of the superior transverse ridge of the occipital bone, and from the external and posterior part of the mastoid process; the fibres on each side ascend, from behind forwards, and from without inwards, and soon terminate in one thin and broad tendon, which extends over the upper and lateral parts of the cranium.—This *cranial aponeurosis* having arrived

opposite the coronal suture, ends in two fleshy portions, broader and thicker than the posterior extremities of this muscle ; these anterior portions, which are thicker externally than internally, descend over the frontal bone, and are *inserted*, fleshy on each side, into the integument of the eyebrow, mixing with the fibres of the corrugátor-supercilii and orbicularis palpebrarum muscles ; a small fleshy slip is often continued down along the nasal bones, and is attached to the angular process of the os frontis, and inferiorly to the nasal bones or cartilages : this slip is described by some as a distinct muscle, under the name of *pyramidalis nasi*, or fronto-nasalis.—*Use.* The occipito-frontalis muscle can raise the eyebrows and integument of the forehead into transverse wrinkles, draw the eyebrows a little outwards, and make tense the skin of the upper eyelids ; also pull the scalp backwards ; but if the eyebrows be depressed and fixed, this muscle can then (particularly in some persons), draw the scalp downwards and forwards. This muscle is very closely connected to the scalp, particularly in front, but loosely to the cranium, it can thus move easily on the latter, carrying with it the former. Its origin is connected with the sterno-mastoid, trapezius and splenius muscles, and its insertion with those of the eyebrows. Some describe the occipito-frontalis, not as one, but as four distinct muscles, two on each side, under the names of the occipital and frontal muscles of each side, and consider the cranial aponeurosis as their common insertion. Several vessels and nerves perforate this muscle, and ramify on its surface and in the integument, viz. anteriorly, the supraorbital branches of the ophthalmic nerve and artery ; laterally, the temporal and posterior auris arteries with branches of the portio dura and inferior maxillary nerves, and posteriorly, the occipital arteries spread their branches upwards and forwards, accompanied by the occipital nerves, branches of the cervical plexus : the integuments in this region are thus abundantly supplied with vessels and nerves from different sources, a circumstance not only of anatomical but of practical importance.

The common muscles of the ear are three in number, viz. superior, anterior, and posterior auris :

Superior Auris, or Attollens Aurem, is a small, thin, triangular muscle, *arising* tendinous from the cranial aponeurosis on the side of the cranium, just above the external ear ; the fibres descend converging, become fleshy, and are *inserted* into the upper and anterior part of the cartilage of the ear ; —*use*, to raise the cartilage, and deepen its cavity. This muscle is between the skin and temporal fascia.

Anterior Auris, or Attrahens Aurem, is connected with the last, is small, and often indistinct; it *arises* from the posterior part of the zygomatic process, and from the cranial aponeurosis, passes backwards and downwards, and is *inserted* into the anterior part of the helix ; *use*, to draw the external ear forwards and upwards. This muscle is superficial, and lies on the temporal fascia, vessels and nerves.

Posterior Auris, or Retrahens Aurem, often consists of two or three distinct fasciculi, it is the strongest of these auricular muscles ; it *arises* from the mastoid process above the sterno-mastoid muscle, passes forwards, and is *inserted* into the back part of the concha. This muscle is covered only by the skin, and lies on the temporal bone.

In addition to these muscles, which move the external ear, there are several

small muscles attached to different parts of the cartilages, which serve to alter their form, and expand their cavities; these muscles, as also those in the tympanum, shall be described hereafter in the dissection of the organ of hearing.*

§ 2.—*Dissection of the External Parts of the Face.*

The muscles of the *face* require careful dissection: they are delicate, and often very pale; they may be classed into the superficial and deep: the former into those of the eyelids, nose, mouth, and lips; the latter into those of the lower jaw and palate. Make an incision around the base of the orbit, through the skin, which is here very fine, and closely adhering to the fibres of the orbicularis muscle; next make a perpendicular incision along the middle line of the nose, to the centre of the upper lip, continue this in a semicircular manner round the angle of the mouth to the middle of the lower lip, and thence to the chin, and lastly from the chin to the angle of the jaw; reflect the integuments cautiously from the eyelids and side of the face, as far back as the ear, avoiding the slender muscular fibres which adhere to the skin, and the vessels and nerves which will be exposed in this dissection.

Orbicularis Palpebrarum, broad and thin, somewhat oval, in some subjects very pale and indistinct, in others strong and well marked, *arises* by several fleshy fibres from the internal angular process of the os frontis, and from the upper edge of a small horizontal tendon, (which *tendon* is about one quarter of an inch in length; it is *inserted* internally into the upper edge of the nasal process of the superior maxillary bone, thence it passes outwards and backwards as far as the caruncula lachrymalis, and divides into two slips, which are *inserted* into the tarsal cartilages, and the lachrymal ducts;) the fleshy fibres then proceed in curves, upwards and outwards, along the upper edge of the orbit, the eyelid, and tarsal cartilage, as far as the temple and external commissure of the eyelids; thence the fibres curve in a similar manner along the inferior eyelid and edge of the orbit to the internal canthus, where the fibres are *inserted* into the nasal process of the superior maxilla, and into the inferior edge of the horizontal tendon.—*Use,* to close the eyelids, chiefly by depressing the superior; to press the tears inwards towards the puncta lachrymalia; the superior and external fibres can also depress the eyebrow, and thus oppose the occipito frontalis; the inferior fibres can raise the cheek, draw the lower eyelid inwards, and compress the lachrymal sac which they cover. This muscle is covered by and adheres to the skin; superiorly it intermixes with the occipito-frontalis, and covers the corrugator supercilii, the frontal vessels and nerves, the tarsal cartilage, and levator palpebræ superioris; inferiorly it intermixes with the muscles of the cheek and lips, and sometimes with the platisma myoides, and covers the inferior eyelid, the origin of the levator anguli oris and the infra-orbital vessels and nerves. The external or *orbital* fibres of this muscle are strong and red, and run circularly round the base of the orbit; the middle or *palpebral* fibres are pale, thin, and scattered,

* Previous to, or immediately after dissecting the muscles of the face, the student should examine the brain, the description of which organ will be found at the head of that of the nervous system.

and are contained in the eyelids: the internal or *ciliary* portion is a thick but pale fasciculus, situated under the ciliæ, at the edge of each eyelid. The palbebral and ciliary portion adhere more closely to the skin, and present an elliptical appearance, as the fibres, from the upper and lower eyelid, intersect each other at the outer canthus, and adhere to the ligament of the external commissure. The horizontal tendon of this muscle (*tendo palpebrarum* or *tendo oculi*) passes across the lachrymal sac a little above its centre, and a strong aponeurosis, derived from its upper and lower edge, covers all the anterior surface of the sac, and adheres to the margins of the bony gutter, in which it is lodged. This tendon can be seen or felt through the integuments during life, particularly when the muscle is in action, or when the eyelids are drawn towards the temple. In the operation of opening the lachrymal sac, the incision should commence immediately below this tendon, and be carried obliquely downwards and outwards, to the extent of about half an inch. Separate the orbicularis from the occipito-frontalis over the internal half of the superciliary arch, the tensor tarsi and the corrugatar supercilii will be exposed.

Tensor Tarsi, *arises* tendinous from the posterior edge of the os unguis, passes forwards, divides into two portions, which are *inserted* into the lachrymal ducts, along which the fibres extend nearly as far as the puncta: *use* to draw the puncta and eyelids into close contact with the eye, also to press the puncta towards the nose, to compress the lachrymal sac, and to force out the secretion from the follicles of the caruncula lacrymalis.

Corrugator Supercilii, *arises* fleshy from the internal angular process of the os frontis, passes upwards and outwards, and is *inserted* into the middle of the eyebrow, mixing with the orbicularis and occipito-frontalis muscles; *use*, to depress and approximate the eyebrows, throwing the skin of the forehead into vertical wrinkles: this pair of muscles cannot act separately; they directly oppose the occipito frontalis. They are covered by the orbicularis and occipito-frontalis, and lie on the os frontis and on the frontal nerve and vessels.

Pyramidalis Nasi, long, thin, often wanting, *arises* from the occipito-frontalis, decends close to its fellow, along the nasal bones, becomes broad and aponeurotic, and is *inserted* into the compressor nasi muscle. *Use*, it raises the skin covering the ossa nasi.

Compressor Nasi, is thin and triangular, placed on the side of the nose; it *arises* from the canine fossa in the superior maxilla; the fibres pass forwards, expanding over the ala nasi, and are *inserted* by a thin aponeurosis into the dorsum of the nose, joining some fibres from the opposite side; *use*, to press the ala toward the septum, or to draw it from it, so that it may alternately enlarge or diminish the anterior nares. The insertion of this muscle is connected with the occipito-frontalis, and its origin with the following muscle.

Levator Labii Superioris, Alæque Nasi, is long and thin, placed on the side of the nose, between the orbit and the upper lip; it *arises* by two origins, 1. from the upper extremity of the nasal process of the superior maxilla; 2. broad, from the edge of the orbit, above the infra orbital hole; the fibres descend and converge a little, and are *inserted* into the ala nasi, and into the upper lip and orbicularis oris muscle: its name denotes its *use*. The external or orbital origin of this muscle is covered by the orbicularis palpebrarum; the

angular vein and artery separate its origins ; the orbital head covers the infra-orbital nerve and vessels and the levator anguli oris muscle.

Zygomaticus Minor is very small, and sometimes wanting ; it *arises* from the upper part of the malar bone, passes downwards and forwards, and is *inserted* into the upper lip near the commissure, uniting with the other muscles which are inserted there ; *use*, to draw the angle of the mouth upwards and outwards, as in smiling.

Zygomaticus Major, is long and narrow, and inferior to the last ; *arises* tendinous and fleshy from the lower part of the malar bone, near the zygomatic suture : it descends obliquely forward, and is *inserted* into the angle of the mouth.—*Use*, to draw the corner of the mouth upwards and backwards. The zygomatic muscles are partly concealed at their origin by the orbicularis palpebrarum ; their insertion intermingles with the levator, depressor anguli and orbicularis oris muscles ; they lie on the malar bone, and cross the masseter and buccinator muscles ; they are imbedded in much soft adipose substance.

Levator Anguli Oris, is situated about the middle of the face, behind the orbital portion of the levator labii superioris alæque nasi ; *arises* from the canine fossa below the infra-orbital foramen, and above the alveolus of the first molar tooth ; it descends obliquely forward, and is *inserted* narrow into the commissure of the lips, and into the orbicularis oris ; its name denotes its *use*. This muscle is covered by the orbicularis palpebrarum, levator labii superioris alæque nasi, and by the zygomatic muscles, also by the infraorbital nerve and vessels, and by a quantity of soft adeps ; it lies on the superior maxilla and on the mucous membrane of the mouth.

Depressor labii superioris Alæque Nasi, a small flat muscle, exposed by everting the upper lip, and raising the mucous membrane on the side of the frænum of the lip ; it *arises* from the alveoli of the canine and incisor teeth of the superior maxilla, ascends obliquely forwards, and is *inserted* into the integuments of the upper lip, and into the fibro-cartilage of the septum and ala nasi ; *use*, to press the lip against the anterior teeth, and even to draw it under these, also to depress the septum and ala nasi.

Depressor Anguli Oris, flat and triangular, *arises* broad and fleshy from the external oblique line on the outer side of the lower jaw, extending from the anterior edge of the masseter muscle to the mental foramen ; the fibres ascend converging, and are *inserted* narrow, into the commissure of the lips ; its name denotes its *use*. This muscle is covered by the skin, some of its fibres are continuous with those of the platisma myoides ; it overlaps the buccinator and the following muscle.

Depressor Labii Inferioris, broad and somewhat square, *arises* from the side and front of the lower maxilla, just above its basis, and continues as far forwards as the middle line ; the fleshy fibres intermixed with fat, ascend a little inwards, decussating with some of the opposite muscle, and are *inserted* into half of the lower lip, and into the orbicularis oris ; its name denotes its *use*. This muscle is covered by the skin, and partly by the depressor anguli oris ; by separating these muscles the mental nerve and vessels are exposed : it lies on the mucous membrane, and on the following muscle.

Levator Lanii Inferioris, is exposed by turning down the lower lip, and raising the mucous membrane by the side of the frænum ; *arises* from the alveoli of the incisor teeth of the lower maxilla, by the side of the symphisis ;

the fibres diverge as they descend obliquely forwards between the mucous membrane and the depressor labii inferioris; *inserted* into the integuments of the chin; *use*, to elevate the chin and lower lip: this muscle is analogous to the depressor of the upper lip.

Orbicularis Oris, surrounds the opening of the mouth; consists of two fleshy fasciculi, one for either lip, placed between the skin and mucous membrane, and constituting the chief thickness of the lip; these fasciculi decussate each other at the commissures, and intermix with all the muscles inserted there; *use*, to approximate the lips and regulate their motions in the act of speaking, also to close the mouth, and to oppose the action of the several muscles which are inserted into the commissures. This muscle has no bony attachment; its fibres are blended with fat, particularly on their cutaneous surface; internally they are more smooth and distinct.

Buccinator, is broad, thin, and somewhat square; *arises* posteriorly from the two last alveoli of the superior maxilla, as far back as the pterygoid process, from the external surface of the posterior alveoli of the lower maxilla, as far back as the coronoid process, and form a strong aponeurosis, named the *intermaxillary ligament*, which extends from the pterygoid plate to the root of the coronoid process, and which affords attachment to the superior constriction of the pharynx posteriorly, and to the buccinator anteriorly. From these three origins the fibres pass horizontally forwards, converging a little, and are *inserted* into the commissure of the lips, where they intermix with those of the orbicularis and the other muscles at the angle of the mouth. *Use*, to press the cheek against the teeth, so as to push the food between them, and diminish the cavity of the mouth; also to retract the commissure of the lip. The buccinator is covered by a considerable quantity of fat, which often extends in the form of large, soft, round masses beneath the masseter muscle; also by the zygomatic and depressor anguli oris muscles; several branches of the facial artery and vein, and of the seventh and fifth pair of nerves ramify on its surface, it lies on the mucous membrane. and on a number of small round mucous glands called buccal; this muscle is perforated near its superior posterior third by the duct of the parotid gland, opposite the third superior molar tooth.

The deep muscles of the face, which are connected with the lower maxilla, and are employed in the process of mastication, and the masseter, temporal, internal, and external pterygoid of each side; previous to dissecting these, the student should examine the situation and connection of the parotid gland, one of the salivary glands. There are six *salivary glands*, three on each side, the parotid, submaxillary, and subtingual.

The Parotid Gland is the largest of these conglomerate glands; it derives its name from its proximity to the ear; it is exposed by dissecting off the integuments, and a dense fascia which covers and adheres to it; this fascia is continued from that of the neck, spreads over the gland, is closely connected to the cartilaginous part of the meatus auditorius, and sends numerous processes into the gland in every direction, serving to separate its lobules and to conduct the different vessels through its substance. The parotid gland is of an irregular square figure, and of a pale color, filling the space between the ramus of the inferior maxilla and the ear, bounded above by the zygoma, below by a line drawn from the angle of the jaw to the mastoid process,

posteriorly by the meatus auditorius, the mastoid process and sterno mastoid muscle, anteriorly by the masseter muscle, the posterior third of which it overlaps. Its external surface is rather flat, but the internal is very irregular; it sinks in behind the jaw, fills the deep excavation between this bone and the ear, rests against the styloid process of the temporal bone, the internal carotid artery, jugular vein, and the large nerves connected with these vessels; it also fills the posterior part of the glenoid cavity in the temporal bone, and adheres to the capsular ligament of the maxilla, and inferiorly it is wedged in between the internal pterygoid, digastric and styloid muscles. The external carotid artery and several of its branches, with their accompanying veins and branches of the inferior maxillary and cervical nerves, pass through this gland; the plexus of the portio dura, or facial nerve, also traverses it from behind forwards, and gives off numerous branches in its substance: this plexus is superficial to the artery, and in some cases between it and the veins. Several absorbent glands are connected to it, particularly to its inferior part; frequently one or two, very small, may be found imbedded in its substance in front of the meatus auditorius. From the anterior and superior part of the gland there passes forwards a small white tube, called *Steno's duct*, or the *parotid duct;* this duct arises from the union of numerous small tubes, which issue, each, from one of the granulations of the gland; it passes forwards over the masseter muscle about an inch below the zygoma, parallel to a line drawn from the tube of the ear towards the tip of the nose; it winds round the anterior edge of the masseter, beneath the zygomatic muscles and through a quantity of soft adeps, pierces the buccinator, and opens through the mucous membrane of the mouth by a very small hole opposite the 2d or 3d superior molar tooth, about half an inch from the junction of the cheek with the gum. Between the duct and the zygoma, a small glandular mass is frequently found; it appears like a detached lobe of the parotid, it is named the socia parotidis; from the lower and anterior part of this process, a small duct proceeds, which after a short course unites with the duct of Steno; in some this duct opens distinctly into the mouth. The transverse artery of the face, and several branches of the facial nerve, accompany this vessel, and in general the artery is superior to it, while the nerves wind around it.

The parotid gland is composed of numerous small granulations, united together by cellular tissue, and by branches of blood-vessels and nerves, and by the small roots of its excretory duct. This duct appears much larger than its calibre really is; it is formed of two coats, the external, white, fibrous and dense, commences beyond the anterior edge of the gland, and ends at the buccinator muscle, and the internal, a fine delicate mucous membrane, is continuous with that lining the mouth: the canal is larger at the commencement and at the buccinator than in the intervening space, or at the orifice in the mouth.

Divide the parotid duct, and raise off the gland from the mastoid muscle, and from the ramus of the jaw, observing at the same time its several deep-seated connections. Next clean the masseter muscle and the temporal aponeurosis.

Masseter is thick and strong, covers the ramus and angle of the jaw, and consists of two portions, one anterior, the other posterior; these decussate each other; the anterior *arises* chiefly tendinous from the superior maxilla,

where it joins the malar bone; also from the inferior edge of the latter, the fibres pass downwards and backwards, and are *inserted* fleshy into the outer surface of the angle of the lower maxilla. The posterior or deep portion of the muscle *arises* chiefly fleshy, from the edge of the malar bone and from the zygomatic arch, as far back as the glenoid cavity; the fibres descend, some vertically, others obliquely forwards, and are *inserted* chiefly tendinous, into the external side of the angle and ramus of the jaw, as high as the coronoid process. *Use*, if both portions act together, they will elevate the lower jaw, if the anterior portion act alone, it will carry the jaw forwards and upwards; and if the posterior act alone it will move it backwards and upwards. Thus the masseter muscles of opposite sides, by the alternate action of their different portions, are powerful agents in mastication; they not only cause the division of the food by the direct elevation and pressure of the lower maxilla against the upper, but they can also triturate it, by the great lateral motion of the jaw which they are capable of exerting. The masseter is covered by the skin, some fibres of the platisma, a portion of the parotid gland, its excretory duct, and accompanying vessels and nerves, and by the zygomatic muscles. It lies on the ramus of the jaw, and conceals the insertion of the temporal and the origin of the buccinator, from which it is separated by a great quantity of fat; the superficial layer covers the deep one, except a small portion of the latter near the articulation of the maxilla; strong tendinous septa pass from the surface of this muscle through its substance, and adhere to the ramus of the bone beneath.

Temporalis, is concealed by the temporal aponeurosis, the zygoma, and the masseter. The *aponeurosis* is very strong and tense, of a semicircular form, adhering by its superior convex border to the semicircular ridge on the side of the cranium, which extends from the external angular process of the frontal as far back as the mastoid process of the temporal bone, and by its inferior straight margin to the upper edge of the zygoma; this fascia consists of two laminæ, which are very distinct inferiorily, some fat being interposed; the fibres composing the external layer run longitudinally, those of the internal irregularly. The temporal aponeurosis confines the muscle in its place, and gives additional origin to its fibres. Separate the masseter from its superior attachment, divide with the saw the zygoma at either end, and elevate it together with the lower part of the temporal fascia; the temporal muscle will be thus exposed. It *arises* from all the side of the cranium beneath the semicircular ridge on the parietal bone, and from all the temporal fossa and fascia; the fibres, therefore, are attached internally to the parietal, frontal, and temporal bones, also to the sphenoid as low down as the crest at the root of its great wing; anteriorly to the malar bone, and externally to the inside of the temporal fascia, and to the zygomatic arch. The fleshy fibres all descend converging; the middle nearly vertical; the anterior with a little obliquity backwards; the posterior, which are very long, pass nearly horizontally forwards, over a smooth surface at the root of the zygoma, and the inferior fibres, which arise from the crest on the sphenoid bone are very short, and past transversely outwards.

Inserted by a strong tendon into the coronoid process of the inferior maxilla; it surrounds that process, and is continued along its fore part as far as the last molar tooth. *Use*, to raise the lower jaw when the whole muscle acts;

the anterior fibres may also advance the jaw, and the posterior long fibres can draw it backwards, while the inferior transverse fibres, which are nearly parallel to the external pterygoid muscle, may assist in the lateral and rotatory motions of the jaw; this muscle, particularly its posterior portion, is the greatest security which the jaw possesses against dislocation. The temporal muscle is covered by the integuments, occipito frontalis, superficial temporal vessels and nerves, temporal fascia, zygoma and masseter; it lies on the side of the cranium, and covers the deep temporal vessels, and part of the external pterygoid and buccinator muscles. The temporal muscle consists of two laminæ of fleshy fibres, with an aponeurosis or tendon concealed between them.—Remove the temporal, masseter and buccinator muscles, also the zygomatic arch, saw or break off, low down, the coronoid process, dissect away some fat, and the pterygoid muscles will be exposed, the dissection of which may be still further facilitated by dividing the side of the lower jaw in front of the insertion of the masseter, and then drawing the angle and ramus backwards and forwards.

Pterygoideus Internus is strong and thick, placed on the inner side of the ramus of the jaw, *arises* tendinous and fleshy from the inner side of the external pterygoid plate, and pterygoid process of the palate bone; it fills the greater part of the pterygoid fossa, descends obliquely outwards and backwards, and is *inserted* tendinous and fleshy into the inner side of the angle of the jaw, and into the rough surface above it. *Use*, to elevate the jaw, if the muscles of the opposite side act together; if, alternately, they can rotate it, each moving the jaw laterally, so as to turn it to the opposite side. This muscle is larger than the external pterygoid, inferior and external to which it lies, the term internal only referring to the relation of ~~its origin~~. The tensor palati, superior constrictor, and submaxillary gland, are in contact with it internally: the ramus of the jaw is external to it, and separated from it by the dental artery and nerve, which are protected from the pressure of the muscle by the internal lateral ligament of the jaw: the lower extremity of this muscle is superficial, and lies between the parotid and submaxillary glands.

Pterygoideus Externus is short and triangular, placed at the lower part of the temporal fossa, *arises* broad and fleshy from the outer side of the external pterygoid plate, from the crest on the great wing of the sphenoid, and from the back part of the tuberosity of the superior maxilla; the fibres pass outwards and backwards, nearly horizontal and converging, are *inserted*, tendinous into the anterior and internal part of the neck of the lower jaw, and of the interarticular cartilage. *Use*, to draw forward the jaw and interarticular cartilage; if only one act, it will turn the jaw to the opposite side, so as to triturate or grind the food. These muscles are the chief agents in producing dislocation of the jaw; when the mouth is widely opened their spasmodic action may suddenly draw the condyles forwards off the tubercles into the zygomatic fossæ. The external pterygoid muscle lies in a transverse direction beneath the base of the cranium, and much further from the surface than the internal pterygoid, superior to which it lies; it is internal, and inferior to the temporal muscle, and is also concealed by the masseter. As the external and internal pterygoid muscles arise so near each other, and thence pass in different directions to their insertion, the external going transversely, and the internal descending, they leave between them a triangular space, which

contains a quantity of fat, a small portion of the parotid gland, the internal maxillary artery and vein, and the dental and gustatory branches of the inferior maxillary nerve.

§ 3.—*Vessels and Nerves of the Face.*

The arteries which are to be met with in the dissection of this region, are the facial and the terminating branches of the external carotid; the nerves are branches of the 7th and 5th pair. The *facial artery* which is a branch of the external carotid, is seen winding round the side of the jaw, anterior to the masseter, and running in a contorted course towards the commissure of the lips, and thence ascending along the side of the nose to the internal canthus of the eye, in this course it sends off, numerous *muscular branches*, the *coronary arteries of the lips*, the *nasal branches*, and terminates in the *angular branch* which communicates with the ophthalmic artery at the inner side of the orbit. The facial artery and its divisions are accompanied by corresponding veins; the *facial vein* at the lower edge of the jaw, generally, but not always, divides into two branches, one, superficial, joins the external jugular vein, the other passing deeper in the neck, joins the internal jugular. *The external carotid artery*, which is seen ascending from the neck into the parotid gland, gives off numerous branches to its several lobules, and to the ear, and a little below the latter divides into the transversalis faciei, temporalis superficialis and maxillaris interna. *The transverse artery of the face* crosses the masseter above, sometimes below the parotid duct, and divides into small muscular branches, some of which communicate with the facial and infraorbital arteries. *The temporal artery* ascends behind the articulation of the maxilla on the temporal aponeurosis, and soon divides into an anterior and posterior branch; the former is directed towards the forehead, supplies the integuments and muscles there, and communicates with the frontal branches of the ophthalmic artery; the posterior division of the temporal runs tortuously upwards and backwards, and divides into numerous branches, which supply the integuments and inosculate with the occipital and posterior auris arteries. *The internal maxillary artery* is the largest branch of the carotid; it bends in behind the neck of the lower jaw, between the bone and the internal lateral ligament, then runs tortuously between the pterygoid muscles, upwards, forwards, and inwards to the lower and back part of the orbit, where it sinks into the spheno-maxillary fossa; in this course it sends off the *middle artery of the dura matter*, the *inferior dental*, several *muscular branches* to the temporal, masseter, pterygoid and buccinator muscles, and terminates by dividing into the *nasal*, *descending palatine*, and *infraorbital arteries*. Veins accompany these different arteries, and in the parotid gland we find the temporal and intermaxillary veins forming, by their junction, a considerable vessel called the external jugular vein, which will be afterwards seen descending superficially in the neck. (For the particular description of the blood-vessels of the face, see the Anatomy of the Vascular System.)

The nerves which are met with in the dissection of the face are branches of the 7th and 5th pair; those of the 7th, or the portio dura, have in general a *transverse* direction from behind forwards, are remarkable for their

plexiform arrangement, and have numerous communications with the three branches of the 5th, which are distributed chiefly in a *vertical* direction along the anterior part of the face. The *portio dura* escapes from the temporal bone through the stylomastoid hole, turns forwards into the parotid gland, in which it divides into two large branches, which subdivide and join again by several filaments forming the plexus, named *pes anserinus*, or *parotidæan plexus*, from which several nerves proceed; some ascend obliquely forwards to the temple and forehead, others pass transversely to the muscles of the face, and several descend, some parallel, and others inferior, to the side of the lower maxilla.

The 5th pair of nerves consists of three portions, viz., the ophthalmic, superior maxillary, and inferior maxillary; a branch of each of these divisions is met with in the dissection of the face. The *frontal* nerve, which is a branch of the ophthalmic, or first division of the 5th, is seen escaping from the orbit by the superciliary notch or foramen; it then ascends on the forehead, distributes its branches to the integuments and muscles, and communicates with the portio dura. The *infra-orbital* nerve, which is a branch of the superior maxillary, or second division of the 5th, is observed passing out of the infra-orbital foramen, behind the levator labii superioris alæque nasi, and dividing into several branches; the most of these pass obliquely downwards, and communicate freely with branches of the 7th pair. Through the mental foramen the *mental nerve* escapes; this is a branch of the inferior maxillary, or third division of the 5th pair; most of its branches ascend to the muscles of the lower lip, and several communicate with the portio dura.—(For the more particular description of the nerves of the face, see the Anatomy of the Nervous System.)

The mouth, fauces, and palate, are the parts of the face next in order to be examined; but as these are connected and continuous with the pharynx, and as this organ cannot be seen until the muscles of the neck have been removed, the student had better postpone the dissection of the former until he has become acquainted with the anatomy of the latter; we shall therefore proceed next to the dissection of the neck.

CHAPTER II.

DISSECTION OF THE NECK.

§1.—*Of the Muscles.*

RAISE the shoulders of the subject by blocks placed beneath them, so as to make tense the muscles in this region; divide the integuments near to, and in a line with the clavicle, also along the side of the jaw from the chin to the mastoid process; connect these incisions by another made in a perpendicular direction, in the middle line from the chin to the sternum; dissect off the integuments from before backwards, in an oblique direction, from the chin towards the clavicle; this should be done cautiously, to avoid injuring the platysma or fascia. The platysma myoides will be now fully exposed, and the sterno-mastoid and hyoid muscles partially so; in the middle line of the neck a chain of projections may be observed, which can also be felt during

life, viz. a little below, but at some distance behind the chin, is the body of the os hyoides; inferior to this is the angle of the thyroid cartilage; next is the cricoid, below which the commencement of the trachea may be felt, on the fore part of which the soft swelling of the thyroid gland can be discerned; and lastly, the continuation of the trachea descending into the chest.

Platysma-myoides, or latissimus colli, is a thin cutaneous muscle, in many subjects weak, and even indistinct; its figure is somewhat square, being a little longer than it is broad; it *arises* by many fine fleshy fibres from the cellular membrane, covering the upper part of the deltoid and pectoral muscles; a few also adhere to the clavicle; the fibres ascend obliquely inwards, at first loosely, afterwards closely connected to each other, and form a broad thin muscle, covering the side of the neck, *inserted* 1st, into the chin, decussating there with fibres from the opposite side; 2d, into the fascia along the side of the lower jaw, a few only into the bone; some fibres may be traced high on the face, and seen to join the depressor anguli oris, the zygomatic and orbicularis palpebrarum muscles; and 3d, into the fascia, which covers the parotid, and which adheres to the meatus auditorius. *Use*, to depress the angle of the lips and the lower jaw, but if the mouth be closed it may elevate the integuments of the neck; it also serves to compress and support the several muscles, glands, and vessels in this region. The platysma is covered only by the skin; it partly conceals the clavicle, the sterno-mastoid, hyoid, and thyroid muscles; also the digastric and stylo-hyoid, the sub-maxillary gland, and lower part of the parotid; also, in part, the *external jugular vein:* this vein commences in the parotid gland, descends obliquely outwards over the sterno-mastoid muscle, where it lies very superficial, and then sinks behind the clavicle, and joins the subclavian vein or some of its branches. The upper portion of the external jugular vein is accompanied by a large nerve, *superficialis colli,* a branch of the cervical plexus ascending to the parotid gland and external ear.

This vein in its course down the neck receives several cutaneous veins, and frequently communicates with the internal jugular: it presents great varieties in its size and course, and is sometimes even wanting. Superficial veins may also in general be marked descending along the anterior part of the neck: they arise about the os hyoides and upper part of the thyroid gland, and descend beneath some fibres of the platysma along the anterior edge of the mastoid muscle, and end in the internal or external jugular, or in the venæ inominatæ. The fibres of the platysma are closely connected to a layer of condensed cellular tissue, which in some subjects is very strong, and in some situations aponeurotic; this is the *superficial cervical fascia;* this fascia extends over the anterior and lateral parts of the neck; is continued down over the forepart of the thorax, where it becomes cellular and adipose; ascends to the jaw, to which it is attached; expands over the parotid gland and adheres to the cartilage of the ear; in this situation its strength is greatly increased: towards the lateral and posterior parts of the neck it becomes weak like cellular membrane. From the posterior surface of this fascia a lamina of membrane is derived, which passes behind the sterno-mastoid muscle: this is *the deep cervical fascia,* which has some important connections, which may be examined in this stage of the dissection: The deep fascia arises from the superficial, along the anterior edge of the sterno-mastoid muscle, posterior to which

it passes, so that this muscle is enclosed between these membranes: at the lower part of the neck it is strong, and adheres to the inter-clavicular ligament and posterior edge of the sternum. Some loose fatty substance is here interposed between it and the superficial fascia: as the deep fascia extends upwards, it covers and adheres to the sheath of the cervical vessels, and arriving at the space between the trapezius and mastoid muscles, it becomes weak and cellular, inferiorly accompanying the great vessels beneath the clavicle, and superiorly lost on the branches of the cervical plexus of nerves; at the superior and lateral parts of the neck it sinks deep, behind the angle of the jaw, to which it adheres, and is connected to the styloid process of the temporal bone, and to the stylo-maxillary ligament: absorbent glands, the lower part of the parotid, and much cellular membrane here lie between these two fasciæ. In this situation collections of matter often form, the result of cynanche parotidæa, or of inflammation of some of the lymphatic glands: such collections are productive of great inconvenience, causing such swelling and tension as to interfere with the motions of the jaw, and with the act of deglutition. The cervical fasciæ bind down the muscles and support the vessels and glands in this region; at the lower part of the neck they serve to protect the trachea and the upper part of the thorax from the pressure of the atmosphere during inspiration. Dissect off the platysma and superficial fascia, and examine the subjacent muscles.

Sterno-Cleido Mastoideus, long and flat, placed at the anterior and lateral part of the neck, *arises* by a strong flat tendon with fleshy fibres posterior to it, from the upper and anterior part of the first bone of the sternum, also by short aponeurotic and fleshy fibres from the upper and anterior edge of the sternal third, sometimes half of the clavicle; a small triangular space separates these two origins, through which small vessels and some cellular membrane pass: this space corresponds to the sterno-clavicular articulation.

The sternal and longer portion of this muscle ascends obliquely backwards and outwards, and overlaps the clavicular, which ascends vertically; about the middle of the neck they are intimately joined, and are *inserted* by a thin, broad aponeurosis into the upper part of the mastoid process, and into the external third of the superior transverse ridge of the occipital bone. *Use*, the sternal portion can turn the face and head towards the opposite side: the clavicular, can bend the head and neck to its own side, so as to approximate the ear and shoulder; and if the two portions of the muscle on each side act together, they will move the head downwards and forwards.

If the muscles on the back of the neck be in action, so as to fix the vertebræ and head, then these muscles may assist in still further extending the neck, and carrying the head backwards; this appears to be the case in tetanus. This muscle is covered by the integuments, platysma, superficial fascia, external jugular vein, ascending branches of the cervical plexus of nerves, and by a small portion of the parotid gland; it conceals part of the sternum and clavicle, of the sterno-hyoid-thyroid, omo-hyoid, and digastric muscles, also the lower part of the cervical vessels and several glands; the spinal accessory nerve perforates this muscle a little above its centre, and near its posterior surface; this nerve is a division of the eighth pair, it distributes small branches to the mastoid and trapezius muscles, and joins freely with the

cervical plexus: the spinal accessory does not always perforate, but sometimes passes posterior to the mastoid muscle.

The student may remark that the two sterno-mastoid muscles bound a large triangular space situated on the fore part of the neck, the apex at the sternum, the base at the jaw; this is divided by the mesial line into two lateral portions, which are named the anterior lateral triangles of the neck.

Between the mastoid and the trapezius muscle also, on each side, a large triangular space is enclosed, the base formed by the clavicle, the apex by the mastoid process; this space is called the posterior lateral triangle of the neck. Both these triangular regions may be observed to be subdivided into two by the omo-hyoid muscle, which crosses the neck obliquely from the shoulder to the os-hyoides. Thus on each side of the middle line four triangular spaces may be noticed, principally formed by the trapezius, sterno-mastoid, and omo-hyoid muscles; these triangles are distinguished by the terms—1. posterior inferior; 2. posterior superior; 3. anterior inferior; and 4. anterior superior.

The student should examine each of these regions, and consider the parts situated in each. These spaces can be ascertained during life, and therefore an accurate knowledge of the contents of each may be of practical importance. 1. The *posterior inferior triangle* is that small space behind the clavicular portion of the mastoid muscle, between the clavicle and posterior belly of the omo-hyoid muscle: in this space we find the subclavian artery, vein, and brachial plexus of nerves; it is here that the operation of tying the subclavian artery, in case of axillary aneurism, is recommended to be performed. 2. *The posterior superior triangle* is above the omo-hyoid and between the mastoid and trapezius muscles; it contains the cervical plexus of nerves, several lymphatic glands, and a great quantity of cellular membrane. 3. The *anterior inferior triangle* is above the sternal third of the clavicle between the median line and anterior belly of the omo-hyoid; this space contains the carotid artery, jugular vein, and accompanying nerves, covered by the sterno mastoid, hyoid, and thyroid muscles. 4. The *anterior superior triangle* is between the sterno-mastoid and anterior belly of the omo-hyoid muscles; the apex is formed by the decussation of these muscles, and is opposite the cricoid cartilage; the base is, superiorly, marked by the digastric muscle and lingual nerve;—this space also contains the great vessels and nerves which here however are only superficially covered, so that in this situation the operation of tying the carotid artery can be more easily effected. Divide the sterno-mastoid muscle about its centre, and reflect each portion towards its attachment; at the lower part of the neck, behind and between the sterno-mastoid muscles, are seen the following:

Sterno-Hyoideus is long, flat and thin, *arises* from the posterior surface of the first bone of the sternum, cartilage of the first rib, sternal end of the clavicle, and sterno-clavicular capsule; ascends obliquely inwards, approximating its fellow above, and is *inserted* into the lower border of the body of the os hyoides. *Use*, to depress the os hyoides, pharynx and larynx. This muscle is covered by the sternum and clavicle, by the sterno-mastoid and integuments; it lies on the sterno-thyroid, crico-thyroid, and thyro-hyoid muscles, and on the thyroid gland and its vessels; a tendinous line often

intersects it about its centre.—Cut this muscle across and reflect each portion towards its attachments, and we see the following pair of muscles:

STERNO-THYROIDEUS is broader and shorter than the last, *arises* from the posterior surface of the sternum and cartilage of the second rib, ascends obliquely outwards, and is *inserted* into the oblique line on the ala of the thyroid cartilage. *Use*, to depress the larynx. This muscle is covered by the sterno-mastoid and hyoid muscles, and by the skin; it conceals the vena innominata and carotid artery, the thyroid gland, and the trachea; between it and the latter there is a considerable quantity of cellular membrane which contains several veins (*inferior thyroid* v). Several filaments of the descendens noni nerve are distributed to this and to the former muscle. It is between the sterno-thyroid muscles that the operation of tracheotomy is performed, while that of laryngotomy is between the sterno-hyoid muscles and between the thyroid and cricoid cartilages.

OMO HYOIDEUS is long, slender, and digastric, *arises* broad and fleshy from the superior costa of the scapula behind its semilunar notch, from the ligament covering that notch, sometimes from the base of the coracoid process, and sometimes also from the acromial end of the clavicle; it ascends obliquely forwards a little above the clavicle, passes beneath the sterno-mastoid muscle, where it is generally tendinous, except in the very young subject; becoming again fleshy, it ascends nearly vertical along the outer side of the sterno-hyoid, and is *inserted* fleshy into the lower border of the os hyoides at the junction of its body and cornu. *Use*, (the muscle of one side cannot act independent of the other,) both draw the os hyoides, pharynx, and larynx downwards and backwards, and in deglutition serve to urge the food into the œsophagus. The origin of this muscle is concealed by the trapezius; it lies anterior to the insertion of the levator anguli scapulæ, and between the serratus magnus and supraspinatus muscles: the posterior belly is covered only by the integuments and fascia, and divides the great posterior lateral triangle of the neck into an inferior and superior part, as was before mentioned; this portion of the omo-hyoid can frequently be distinguished in the living neck. The tendon crosses the carotid artery and jugular vein, and is covered by the sterno-mastoid, which can thus move more easily on this structure. The anterior belly and insertion are covered by the integuments and fascia, and this portion of the muscle divides the anterior lateral triangle of the neck into an inferior and superior part. The omo-hyoid crosses over the scaleni muscles, the brachial plexus, phrenic, pneumo-gastric and sympathetic nerves, the carotid artery, and jugular vein.

Beneath the three last described muscles, and lying on the trachea and sides of the larynx, is a large, soft, red mass of a crescentic shape, the concavity directed upwards; this is the *thyroid gland;* it is in general larger in the child than in the adult or old, and in the female than in the male; its size, however, varies considerably in different individuals even of the same sex and age. It consists of two large pyramidal portions, called *lateral lobes*, connected together by a narrow slip, *the middle lobe;* this is thin and flat, and closely connected to the second, third, and fourth rings of the trachea; the lateral lobes are plump and convex, large below, pointed above, placed by the side of the trachea and larynx, and extending as high as the ala of the thyroid cartilage; the left lateral lobe rests on the œsophagus, and both right

and left overlap the carotid artery, inferior thyroid vessels, and recurrent nerve; they are covered by the sterno-mastoid, hyoid, thyroid, and omo-hyoid muscles, by the platysma and skin; they lie on the side of the trachea and larynx, on the crico-thyroid and inferior constrictor of the pharynx. This organ is soft and spongy, the cells contain a yellow, serous, sometimes an oily fluid; it has no excretory duct, although it is supplied by four large arteries; several veins, however, issue from it, particularly from its inferior part. The middle lobe is sometimes deficient; in some cases it passes behind the œsophagus, or between this tube and the trachea, a circumstance which might be productive of great inconvenience, and even danger, in the event of bronchocele (chronic enlargement of this gland) occurring in one in whom this malformation existed. A narrow slip is often seen to ascend from the middle lobe as high as the os hyoides. In the infant the lower part of the thyroid is connected to the thymus gland. The *use* of this organ is not fully ascertained. Next dissect the muscles at the upper part of the neck.

Digastricus, placed at the lateral and anterior part of the neck, thick and fleshy at each extremity, round and tendinous in the centre, *arises* from a groove in the temporal bone, internal to the mastoid process, descends obliquely forwards and inwards, ends in a round tendon which perforates the stylo-hyoid muscle, and is connected to the cornu of the os hyoides by a dense fascia, sometimes by a tendinous ring like a pully; the tendon is then reflected upwards and forwards, and soon ends in the anterior fleshy belly, which continuing forwards and inwards, is *inserted* into a rough depression on the inner side of the base of the jaw, close to the symphysis. *Use*, to depress the lower jaw, and when the mouth is closed, to elevate the os hyoides, tongue and larynx; the posterior belly can also draw these backwards and upwards, and the anterior upwards and forwards, so that this muscle can exert great influence in deglutition; it can also draw the head backwards, if the chin be fixed. The digastric is covered posteriorly by the sterno-mastoid and splenius, and by a portion of the parotid, more anteriorly by a few fibres of the stylo-hyoideus and a small part of the submaxillary gland, by the cervical fascia, platysma and skin; it passes across the styloid muscles, the external and internal carotid arteries, the 8th, 9th and sympathetic nerves; also the origin of the hyo-glossus and insertion of the mylo-hyoid. In the position in which the subject is placed during this dissection, this muscle forms the inferior or convex border of a semicircular space, the superior straight edge of which is marked by the side of the maxilla, and by a line continued from its angle to the mastoid process: this *digastric space* is divided by the stylo-maxillary ligament into a posterior and anterior part. The *posterior* smaller one contains the parotid gland, the carotid artery, and 7th pair of nerves; and deeper than these, the styloid process and origin of the styloid muscles, also the int-carotid, jugular vein, and 8th, 9th and sympathetic nerves. The *anterior* division of the disgastric space contains the submaxillary gland, the facial and lingual arteries; the 9th and gustatory nerves, several small muscles, which connect the tongue and os hyoides to the chin, also the sublingual gland, which cannot be seen in the present stage of the dissection. The student should examine the connections of the submaxillary gland before he dissects the muscles in this region.

The *submaxillary* is the second of the salivary glands, of an oval form and

pale color, surrounded by cellular membrane and several absorbent glands, covered by the skin, platysma and fascia, bounded posteriorly by the digastric tendon, externally by the internal pterygoid muscle and stylo-maxillary ligament; anteriorly by the side of the maxilla, and internally by the anterior belly of the digastric; it rests on the mylostylo-hyoid and hyo-glossus muscles; a small process of the gland accompanies its excretory duct, turns round the posterior edge of that muscle, and lies between its upper surface and the membrane of the mouth; this process frequently joins the sublingual gland. The facial artery and vein pass through a deep groove in this gland. The duct of this gland is called *Whartonian duct*, it *arises* by numerous fine radicles from the lobules of the gland, leaves it at its outer end, winds above the mylo-hyoid muscle, and runs forwards and inwards towards the frænum linguæ, by the side of which it *opens* into the mouth; the orifice can be distinctly seen in a prominent papilla, which appears when the anterior part of the tongue is raised: this duct is about two inches and a half long, is thin and transparent, its coats are weaker, but its caliber is larger than in Steno's duct: the gustatory nerve accompanies this duct, at first superior but afterwards inferior to it. Detach this gland from the mylo-hyoid, turn it outwards, leaving the duct and deep process to be further examined afterwards; separate the anterior belly of the digastric from the chin, and we see the following muscle.

Mylo-hyoideus, triangular, *arises* from the oblique line (the myloid ridge,) on the inner surface of the side of the maxilla, which line descends obliquely from beneath the last molar tooth towards the chin; the fibres descend obliquely inwards and backwards to the mesial line, and *are inserted* into the base of the os hyoides, and along with its fellow, into a middle tendinous line between that bone and the chin. *Use*, to elevate the os hyoides and tongue, so as to press the latter against the palate. This muscle was covered by the gland, and by the digastric; it lies on the hyo-glossus, stylo-glossus, and genio-hyoid muscles, and conceals the Whartonian duct, the lingual and gustatory nerves and sublingual gland. Detach this muscle from the os hyoides and from its fellow; in the middle line we shall then see the following pair.

Genio-hyoideus, short and round, *arises* by a small tendon on the inner side of the chin, above the digastric, descends obliquely backwards, and is *inserted* broad and fleshy into the base of the os hyoides. *Use*, to draw the os hyoides upwards and forwards, to push the tongue against the incisor teeth, or protrude it from the mouth: this pair of muscles lie superior to the digastric and mylo-hyoid, and inferior to the genio-hyo-glossus. Reflect the genio and mylo-hyoid muscles towards the lower jaw, we thus expose superiorly the membrane of the mouth, with the sublingual gland attached to it, close to which is the gustatory nerve; inferior to this the Whartonian duct is seen, and nearer to the os hyoides is the lingual nerve, from which a plexus extends to the gustatory; the hyo and genio-hyo-glossi, and the three styloid muscles are also now exposed. The *sublingual* is the third and smallest of the salivary glands, oblong, placed beneath the anterior and lateral part of the tongue, covered superiorly by the mucous membrane, to which it adheres, and resting inferiorly on the mylo-hyoid, is in contact, internally, with the genio-glossus, and is connected externally to the deep process of the submaxillary gland. This gland opens by several small ducts, some of which join

the Whartonian canal, others perforate the mucous membrane of the mouth, between the tongue and inferior canine, and bicuspis teeth by small openings, which may be observed on a sort of crest or fold of the mucous membrane in this situation. The three salivary glands, though generally separated from each other, yet are in some cases so joined together as to resemble one irregular glandular mass, the parotid being united to the submaxillary behind the angle of the jaw, and the latter being connected to the sublingual around the mylo-hyoid muscle.

Hyo-glossus is flat and thin, *arises* from the cornu and part of the body of the os hyoides, ascends a little outwards, *inserted* into the side of the tongue. *Use,* to render the dorsum of the tongue convex by depressing its side; it may also elevate the os hyoides and base of the tongue. This muscle is covered by the mylo-hyoid in part, and by the sublingual gland and lingual nerve; it lies on the middle constrictor of the pharynx, the lingual artery, and the substance of the tongue.

Genio-hyo-Glossus is triangular, *arises* by a small tendon from an eminence inside the chin, beneath the frænum linguæ; thence the fibres radiate, the superior ascend and turn forwards towards the tip of the tongue, the middle also ascend, some inclining forwards, others backwards; the inferior and posterior pass backwards and downwards to the base of the os hyoides.—*Inserted* into the mesial line of the tongue from the apex to the base, and into the body and lesser cornu of the os hyoides. *Use,* the posterior fibres can draw the os hyoides towards the chin and push the tongue forwards, the anterior can draw back the tongue, and bend its tip down towards the frænum, the middle portion can depress the middle of the tongue and make it concave from side to side; it can also draw it forwards so as to enlarge the opening of the fauces. This muscle is therefore used in mastication and deglutition, also in the articulation of several letters.

The several muscles last described cover this muscle externally; internally it is in contact with its fellow.

Lingualis is a fasciculus of fibres taking a longitudinal course on the inferior surface of the tongue from the base to the apex, and intermixing with the muscles on either side, so that it appears as being derived from these rather than as a distinct muscle; the fibres are attached through their whole length, and are mixed with a soft fatty substance; anteriorly they are broader and more distinct; they are situated between the genio-hyo-glossus internally, and the hyo and stylo-glossi externally. *Use,* to shorten the tongue, and bend the tip downwards and to one side. External to the muscles now described, we see the three styloid muscles.

Stylo-Hyoideus *arises* from the outer side of the styloid process near its base, descends obliquely forwards parallel to the posterior belly of the digastric, whose tendon generally perforates this muscle, *inserted* into the cornu and body of the os hyoides and into the fascia, which connects the digastric tendon to this bone. *Use,* to co-operate with the posterior part of the digastric, in raising and drawing back the os hyoides and tongue. This muscle is nearly superficial, but at first is covered by the parotid; the digastric lies to its external side, and the external carotid artery to its internal: this vessel is posterior to the lower part of the muscle, but anterior to its origin; a ligament often accompanies the stylo-hyoid muscle, from the styloid process to

the cornu of the os hyoides; it is named the stylo-hyoid ligament, and is sometimes ossified. Raise the digastric and stylo-hyoid, and we see the remaining styloid muscles.

Stylo-Glossus *arises* tendinous and narrow from the styloid process near its point, and from the stylo-maxillary ligament; descends obliquely forwards and inwards, and is *inserted* into the side of the tongue; its fibres overlap and unite with those of the hyo-glossus, and can be traced as far as the tip.—*Use*, to draw the tongue backwards, and to one side, and to raise the tip behind the upper incisor teeth. It is covered by the sub-maxillary and lingual glands, by the gustatory nerve and mucous membrane.

Stylo-Pharyngeus, long and narrow, *arises* from the back part of the root of the styloid process, descends inwards and backwards, passes between the superior and middle constrictors of the pharynx, with which it mixes; is *inserted* with these into the side of the pharynx, also into the cornu of the os hyoides and thyroid cartilage. *Use*, to elevate, dilate, and draw forward the pharynx, so as to receive the food from the tongue. It is covered by the stylo-hyoid, middle constrictor and external carotid, and it lies on the superior constrictor, internal carotid, sympathetic and par vagum; the glosso-pharyngeal nerve winds round it.

§ 2.—*Dissection of the Vessels and Nerves of the Neck.*

The arteries which are met with in dissecting the neck are the carotid and subclavian of each side, and their several branches; the veins are the external and internal jugular and subclavian; the nerves are the gustatory branch of the fifth, eighth and the ninth pair, the sympathetic and the anterior branches of the eight cervical and first dorsal spinal nerves. The *right carotid artery* arises from the arteria innominata, behind the right sterno-clavicular articulation; the *left carotid* arises from the upper part of the arch of the aorta; in other respects these arteries are similar; both ascend by the side of the trachea and larynx, surrounded by a sheath of cellular membrane, on the forepart of which are seen the branches of the decendens noni nerve; behind the sheath lies the sympathetic, and within it are the jugular vein, lying to the outside of the artery, and the par vagum nerve, between, and rather behind both these vessels; opposite the os hyoides each carotid divides into two branches, viz. the internal and external; the *internal carotid artery* is the larger branch, lies deeper in the neck, and more external; it ascends along the forepart of the transverse processes of the vertebræ to the base of the cranium, enters this cavity, through the foramen caroticum in the temporal bone, and is distributed to the brain. The *external carotid artery* ascends towards the parotid gland, being crossed by the digastric and stylo-hyoid muscles, and by the lingual and portio dura nerves; in this course it gives off several branches, viz. the superior thyroid, lingual, libial or facial auricular, occipital, pharyngeal, transverse facial, internal maxillary and temporal.

The *subclavian arteries* are situated at the inferior and lateral part of the neck: the *right* arises from the arteria innominata, the *left* from the posterior part of the arch of the aorta; each subclavian artery passes upwards and outwards to the anterior scalenus, behind which it passes; it then turns downwards and outwards behind the clavicle, and over the first rib into the axilla:

the difference in the origin causes an important difference in the situation and connections of the right and left subclavian in the early part of their course, the right being shorter and nearly transverse, lies higher in the neck, and more superficial than the left, which arises deep in the thorax, out of which it ascends perpendicularly before it turns outwards to pass between the scaleni; after this point, these vessels are similar in every respect; each gives off the following branches, viz. arteria vertebralis, mammaria interna, axis thyroidea, cervicalis profunda, and intercostalis superior.

The external jugular vein has been already noticed; the *internal jugular vein* of each side commences at the termination of the lateral sinus in the foramen lacerum posterius, descends along the outer side, first, of the internal, and afterwards of the common carotid artery, and at the inferior part of the neck joins the *subclavian vein*, which returns the blood from the upper extremity, and accompanies the subclavian artery; the junction of each jugular and subclavian, which is posterior to the sternal end of each clavicle, forms the right and left venæ innominatæ; these veins enter the chest, and uniting, commence the superior vena cava, as will be seen in the dissection of the thorax.—For the more particular description of the vessels of the neck, see the anatomy of the vascular system.

The *gustatory nerve* is the principal branch of the inferior maxillary, or third division of the fifth pair; it is seen on dividing the mylo-hyoid, taking an arched course parallel to the stylo-glossus muscle, from within the angle of the jaw towards the tip and side of the tongue; it accompanies the Whartonian duct, and rises above the sublingual gland, between it and the tongue; it gives branches to the submaxillary and sublingual glands, and terminates in fine filaments, which are lost in the papillæ beneath the mucous membrane, covering the sides and tip of the tongue. The chorda tympani joins it near the condyle and parts from it opposite the angle of the lower maxilla; this delicate nerve then swells into a small ganglion, whose branches pass into the submaxillary gland. The *eighth pair of nerves* leave the cranium by the foramen lacerum posterius, anterior to the jugular vein; it immediately separates into its three portions, the internal or glosso-pharyngeal, the external or spinal accessory, and the middle or par vagum. The *glosso-pharyngeal*, is connected to the stylo-pharyngeus muscle, its name denotes its destination; the arch which it forms, as it runs to the base of the tongue, is inferior to and deeper in the neck than the gustatory nerve. The *spinal accessory nerve* separates from the par vagum, and in general winds round behind the internal jugular vein, perforates the sterno-mastoid muscle, as was before mentioned, and distributes its branches to it and to the trapezius; several of these also communicate with the cervical plexus, and descend to the acromion. The *par vagum*, or *pneumo-gastric* descends along the neck, between, and rather behind the carotid artery and jugular vein, and enclosed in their sheath; it then passes through the thorax, and terminates on the stomach. The cervical portion only of this nerve is to be observed at present; from it arise several branches, viz. communicating branches to join the sympathetic and lingual; pharyngeal branches to the side of the pharynx; superior laryngeal nerve, which takes an arched course behind the great vessels to the thyroid cartilage, and is distributed to the upper part of the larynx; and small cardiac branches of the sympathetic nerve. At the inferior part of the neck, on each side

of the trachea, a large nerve, the *inferior laryngeal or recurrent nerve*, is seen; this is also a branch of the par vagum. On the *right* side, this nerve *arises* at the lower part of the neck, turns round the subclavian artery, and passing behind it and the carotid, pursues its course upwards and inwards behind the thyroid gland, to the lower and back part of the larynx; on the *left* side the recurrent nerve *arises* in the thorax, opposite the lower part of the arch of the aorta, under which it passes, and then attaching itself to the forepart of the œsophagus, ascends to the larynx, to the muscles of which it is distributed like that of the opposite side. At the inferior part of the neck the eighth pair of nerves enter the thorax; that of the right side passes anterior to the subclavian artery, crossing it at a right angle; that of the left side descends anterior but parallel to the left subclavian artery. The *ninth pair, or lingual nerve*, leaves the cranium by the anterior condyloid hole in the occipital bone, descends forwards and inwards, nearly parallel to the digastric muscle, and is distributed to the muscles of the tongue: the arch which the course of this nerve describes is parallel, but inferior to that of the gustatory. From the convexity of this arch a long branch arises, the *decendens noni;* this descends along the forepart of the sheath of the carotid artery, communicates with the second and third cervical nerves about the middle of the neck, and is distributed to the sterno-hyoid and thyroid muscles: in some cases this nerve descends within the sheath behind the vein. The *sympathetic nerve* may be found descending along the vertebræ posterior to the carotid artery: this nerve commences at the base of the cranium in a long, oval, red swelling, *the superior cervical ganglion*, which extends as low as the third cervical vertebra; from this the nerve becoming very small, descends almost vertically, and in general opposite the fifth cervical vertebra, it forms a second swelling, called the *middle cervical ganglion;* from this, the small nervous cord continues its course down the neck, and opposite the seventh cervical vertebra and the neck of the first rib, it expands into a large irregular swelling, the *inferior cervical ganglion*, from the lower part of which the nerve descends into the thorax. (For the particular description of the branches of the sympathetic, as well as of the cerebral nerves, met with in the dissection of the neck, *see the Anatomy of the Nervous System.*) On the side of the neck are seen numerous branches of the cervical spinal nerves; there are *eight pair of cervical nerves;* the first, or suboccipital, is very small; the eighth is very large; the first leaves the spinal canal between the occipital bone and the atlas; and the eighth between the last cervical and first dorsal vertebra: these cervical nerves all divide into a posterior and anterior branch, the former are distributed to the muscles and integuments on the back of the neck; the anterior branches of the first, second, third, and fourth, communicate with each other, and give origin to several branches, which again unite with each other, and constitute *the cervical plexus;* this plexus is between the mastoid and trapezius muscles; it sends off several branches, which are entangled with much cellular membrane and several absorbent glands; the anterior branches of the four inferior cervical nerves with that of the first dorsal, unite and form the *brachial plexus;* this is situated at the lateral and inferior part of the neck, and accompanies the subclavian artery beneath the clavicle into the axilla, in which region the plexus divides into several branches to supply the upper extremity and the

muscles on the parietes of the thorax. In the inferior and lateral part of the neck, on each side, the *phrenic nerve* is also seen; this arises by several fine filaments from the third, fourth, fifth cervical nerves; the phrenic nerve descends obliquely inwards along the anterior scalenus muscle, enters the thorax between the subclavian vein and artery, and is distributed to the diaphragm. Previous to examining the deep muscles of the neck, the student should study the anatomy of the mouth, pharynx, and larynx.

§ 2.—*Dissection of the Mouth, Pharynx and Larynx.*

The cavity of the mouth may be exposed by dividing the commissures of the lips and the cheek of one side, and removing a small portion of the side of the lower jaw; draw forward the tongue with a tenaculum, and cleanse the parts very well. The *mouth* is bounded anteriorly by the lips, superiorly by the hard and soft palate, laterally by the cheeks, inferiorly by the tongue, and mucous membrane reflected from it to the gums; posteriorly it communicates with the pharynx: this opening is named the *isthmus faucium;* it is bounded above by the velum and uvula, below by the tongue, and on each side by the arches of the palate. The anterior part of the palate, or *hard palate*, is formed of the palate plates of the maxillary and palate bones, covered by mucous membrane and glands; the posterior part of the palate, or *soft palate*, or *velum pendulum*, consists of a dense aponeurosis, and of several muscles and glands, enclosed in mucous membrane; the *cheeks* are formed of mucous membrane, covered by the buccinator and a quantity of fat; several small mucous glands lie between the membrane and this muscle, and towards the upper and back part on each side we perceive the small opening of Steno's duct. The mouth is lined throughout by mucous membrane, which is continuous with the cutis on the lips, and extends posteriorly through the pharynx, whence it ascends to line the nares, the Eustachian tube and tympanum on each side, and descends to line the œsophagus and larynx; as it is reflected from one surface to another, it forms folds or fræna, as between the lips and alveoli, and beneath the tongue; at the sides of the fauces, also, it forms two semilunar folds on each side, called the pillars or arches of the palate: these folds enclose muscular fibres, which we shall examine afterwards. On looking into the mouth, either in the living or dead subject, the following objects strike the attention; inferiorly the tongue and teeth; laterally the cheeks; posteriorly the back part of the pharynx; superiorly the hard and soft palate, from the centre of the latter, the uvula, and from the sides, the pillars or arches descending to the tongue and pharynx; in the recess between these pillars on each side the tonsil or amygdala is also seen; lastly, if the tongue be drawn forward, the epiglottis comes into view.

The *tongue* is of a triangular shape; its base, thick and broad, is connected to the epiglottis and palate by mucous membrane, and to the os hyoides and inferior maxilla by muscles; the apex is thin and unattached; that portion between it and the base is named the body of the tongue; all the upper surface, the sides, and about one third of its inferior surface, are covered by mucous membrane, which is very rough superiorly, from the number of papillæ that project through it; anteriorly, these papillæ are small, *conical*, and connected with the terminations of the nerves of taste; posteriorly they are

large, round, *lenticular*, and very irregular; these are small glands which open on the mucous surface: near the epiglottis these glandular papillæ are often observed to have a peculiar arrangement, like the letter v, the concavity turned forwards; behind the apex of this angle, a deep depression (foramen cœcum) is observable; this contains some mucous follicles: a superficial groove runs along the dorsum of the tongue, one more distinct exists along the inferior surface, so that this organ is divided by the mesila line into two symmetrical portions; accordingly, in paralysis, one side only of this organ is frequently found affected.* The substance of the tongue is composed of adeps blended with numerous muscular fibres derived from the stylo, hyo, genio-hyo-glossi, and linguales muscles, and of many other fleshy fibres which do not properly belong to any of these: two large arteries (lingual) and six considerable nerves (the gustatory, the lingual and the glosso-pharyngeal, on each side) supply this organ. The tongue is not only the organ of taste, but by its great mobility it assists in speech, in suction and deglutition; the fifth pair of nerves endow the tongue with sensation and with the sense of taste, the ninth with mobility, and the eighth connect its motions with those of the pharynx and stomach.

§ 3.—*Dissection of the Pharynx.*

To obtain a view of the muscles of the pharynx and palate, the student may now make the following dissection; divide the trachea and œsophagus in the lower part of the neck; detach them from the vertebræ, to which they are loosely connected; draw forward these organs, together with the vessels and nerves on either side; place the saw flat on the bodies of the vertebræ; insinuate its edge, between the styloid and mastoid processes on each side, and make a vertical section of the head; we have thus the face and anterior part of the cranium separated from the vertebral column; or, should it be desirable to preserve the cranium, we may separate the occipital bone from the atlas, and then remove from the subject the whole head, together with the organs we wish to examine; distend the pharynx with hair or tow, and remove some of the loose cellular tissue connected to it.

The *pharynx* is a large, muscular, and membranous bag, extending from the base of the cranium to the fourth or fifth cervical vertebra, where it ends in the œsophagus; it is placed behind the nose, mouth and larynx; is somewhat of an oval form, the largest part being opposite the os hyoides, and the smaller extremity joining the œsophagus. The pharynx is attached superiorly and posteriorly to the cuneiform process, by an aponeurosis, which is very strong in the middle line, laterally by a thinner aponeurosis to the petrous bone, and anteriorly, by fleshy fibres to the internal pterygoid plate and hamular process, and to the posterior part of the mylo-hyoid ridge of the lower maxilla;—the pharynx is connected posteriorly to the vertebræ and to the deep muscles of the neck by loose reticular membrane; anteriorly it is attached by mucous

* In hemiplegia, when the muscles of one side of the face are paralysed, it has been remarked, that if the tongue be protruded, the apex will be directed towards the affected side, this phenomenon, which is only an apparent exception, depends on the action of the genio-hio-glossus muscle of the healthy side; which will pull the base of the tongue on that side, towards the chin, and must therefore turn the point to the opposite side.

membrane and muscular fibres to the cornua of the os hyoides and thyroid cartilage, and to the sides of the cricoid, behind which the pharynx abruptly contracts and ends in the œsophagus; on either side of the pharynx, and loosely connected to it, is the sheath of the carotid artery with its accompanying nerves. The muscular fibres which cover the back and sides of the pharynx, are named constrictor muscles; they are symmetrical, and overlap each other; the inferior being most superficial, the middle next, and the superior the deepest; the constrictor muscles of opposite sides have one common insertion into the *middle tendinous line* or raphe on the back part of the pharynx, which line is very strong and distinct superiorly, being *inserted* into the cuneiform process, but inferiorly it is weak and often indistinct.

Constrictor Pharyngis Inferior is somewhat square, *arises* from the side of the cricoid cartilage, from the inferior cornu and posterior part of the ala of the thyroid cartilage, external to the crico-thyroid and thyro-hyoid; the superior fibres ascend obliquely, and overlap the middle constrictor; the inferior fibres run circularly and overlap the œsophagus; *inserted* along with that of the opposite side into the middle line on the back of the pharynx; its origin is covered by the sterno-thyroid muscle and the thyroid gland; this muscle lies on the mucous membrane, except its superior fibres, which are separated from it by the middle constrictor. The inferior laryngeal nerve passes beneath its lower edge, and the superior laryngeal beneath its upper.

Constrictor Pharyngis Medius is of a triangular form, *arises* from the cornu and appendix of the os hyoides, also from the stylo-hyoid and thyro-hyoid ligaments; its fibres expand on the back of the pharynx, the superior ascend to the occipital bone, the middle run transversely, and the inferior descend beneath the lower constrictor, *inserted*, into the mesial tendinous line or raphe, and into the cuneiform process. The lingual artery and hyo-glossus muscle are connected to the origin of this muscle, which part is separated from the inferior constrictor by the superior laryngeal nerve and cornu of the thyroid cartilage, and from the superior constrictor by the stylo-pharyngeus muscle and glosso-pharyngeal nerve; on dividing the edge of this muscle, the Stylo-pharyngeus appears; it *arises* from the root of the styloid process, descends to the side of the pharynx, where it expands between the superior and middle constrictors, and is *inserted* partly along with the latter and partly into the cornu of the thyroid cartilage. *Use*, to elevate and dilate the pharynx, in order to receive the food from the tongue: divide the stylo-pharyngeus, and the superior constrictor will be exposed.

Constrictor Pharyngis Superior, surrounds the superior part of the pharynx; *arises* by a dense aponeurosis from the petrous bone, which soon becomes connected with the next origin, which is fleshy, from the lower part of the internal pterygoid plate and hamular process, also from the intermaxillary ligament which connects it to the buccinator muscle, from the posterior third of the mylo-hyoid ridge, and from the side of the base of the tongue; all the fibres take a semicircular course backwards and inwards, and are *inserted* into the cuneiform process and into the middle tendinous line on the back of the pharynx. The superior constrictor is covered by the styloid muscles and by the great vessels and nerves, and inferiorly by the middle constrictor, from which the stylo-pharyngeus and glosso-pharyngeal nerve separate it: between the attachment to the petrous bone and that to the occipital, the mucous

membrane is uncovered by muscular fibres in a small semicircular space, named *sinus of Morgagni;* this is beneath the cuneiform process, on each side of the middle line, and corresponds to the Eustachian tubes; between the temporal and pterygoid attachments, the muscles of the velum lie, and between the pterygoid and maxillary origins the internal pterygoid muscle and the gustatory nerve are situated. *Use*, the constrictors diminish the capacity of the pharynx, and by the successive contractions of each, the food is forced into the œsophagus; the complex muscular structure of the pharynx may also assist in the modulation of the voice and in the production of certain sounds. Open the pharynx by a perpendicular incision through the middle tendinous line; on looking into the cavity it will be found divided by the velum into two portions, a superior and inferior: *seven openings* also may be remarked leading from it in different directions, viz. in the upper or nasal portion there are the two posterior nares, and on the side of each of these is the opening of the Eustachian tube; below the velum is the isthmus faucium, or posterior opening of the mouth; below and behind the tongue is the opening of the glottis; and lastly, the termination of the pharynx in the œsophagus. The *opening of the nares* are of an oval shape, their long diameter being vertical; the body of the sphenoid bone bounds them superiorly, the palate bones inferiorly, the internal pterygoid plates externally, and the vomer separates them from each other: through these openings the air generally passes during respiration. The *Eustachian tube* open on each side of the posterior nares, behind the inferior spongy bone; they are circular, and look forwards and inwards towards the septum narium, are formed of thick cartilage, covered by mucous membrane; through these air is admitted from the nose into the tympanum, to support the membrana tympani on its inner side. The Eustachian tube must be again examined in the dissection of the organ of hearing.* Beneath the velum is the *isthmus faucium,* transversely oval, but capable of great change in figure and size, bounded above by the velum and uvula, below by the tongue, and on either side by the pillars or arches of the palate, and by the amygdalæ. The opening of the *glottis,* or *superior* opening of the larynx, is at the lower and anterior part of the pharynx, behind the epiglottis, and rather beneath the tongue; it is of a triangular form, the base anteriorly, formed by the epiglottis; the sides are composed of folds of mucous membrane, termed aryteno-epiglottidean, and the apex, which is posteriorly, is formed by the appendices of the arytenoid cartilages. The glottis, which will again be considered in speaking of the larynx, is always open, except in the act of deglutition. The *œsophageal opening* is below and behind the glottis; it is always closed, except in deglutition. The student should next examine the velum pendulum palati, or palatum molle.

§ 4.—*Dissection of the Palate and its Muscles.*

The *velum pendulum palati* is a soft moveable substance, attached superiorly and anteriorly to the hard palate on each side of the tongue and pharynx,

* The student may practise the introduction of a probe into this tube; slightly curve a blunt probe, pass it along the floor of the nose to the posterior nares, then direct its extremity upwards, outwards, and backwards, that is toward the ear, and it will enter this tube.

and posteriorly and inferiorly it terminates in a thin edge, from the centre of which the uvula descends, thus giving a lunated appearance to the edge of the velum on each side; these crescentic edges are named the *half arches* of the palate. The velum is situated obliquely, its fixed edge being superior and anterior to the loose, one surface looking forwards and downwards towards the mouth and tongue, the opposite surface looking upwards and backwards; during life this aspect can be altered by the action of muscles, which can either elevate, depress, or make tense the velum. Beneath the mucous membrane of the velum several small glands are situated, chiefly on the inferior surface. The *uvula* is a conical prolongation of the velum, enclosing small glands, loose cellular membrane, and some muscular fibres; in deglutition, the velum and uvula are raised so as to touch the back part of the pharynx, and thus they are of *use* in preventing the food ascending into the upper or nasal part of the cavity, from which it might regurgitate into the nares. The muscles of the velum are five pair, the levator and tensor palati, the motor uvulæ, palato glossus and palato-pharyngeus.

Levator-Palati, *arises* narrow from the petrous bone, in front of the foramen caroticum and behind the Eustachian tube, descends obliquely inwards, and is *inserted* broad into the velum; its name denotes its *use.*

Tensor-Palati vel circumflexus palati, *arises* fleshy from a depression at the root of the internal pterygoid plate, from the spinous process of the sphenoid, and from the forepart of the Eustachian tube, descends between the internal pterygoid plate and muscle, ends in a flat tendon, which turns round the hamular process inwards to the velum, it then expands, and *joins* that from the opposite side. *Use*, to make tense the velum in a horizontal direction between the hamular processes.

Motor Uvulæ, *arises* from the posterior extremity or spine of the palate bones, descends close to its fellow, along the median line of the velum, and is *inserted* into the cellular tissue of the uvula. *Use*, to raise and shorten the uvula: this pair of muscles are so close that they appear but as one, hence they have sometimes received the name of *azygos uvulæ.*

Palato-Glossus vel constrictor isthmi faucium, or the anterior arch or pillar of the palate, *arises* from the inferior surface of the velum, descends forwards and outwards, enclosed in a fold of mucous membrane anterior to the tonsil. *Inserted* into the side of the tongue. *Use*, to elevate the tongue or to depress the velum, this pair of muscles may close the fauces.

Palato-Pharyngeus, or posterior arch of the palate, *arises* broad from the inferior surface of the palate, arches downwards and backwards behind the tonsil, and is *inserted* into the side and back of the pharynx, and into the cornu of the thyroid cartilage, its fibres mixing with those of the stylo-pharyngeus. *Use*, to elevate the pharynx, like the stylo-pharyngei in the commencement of deglutition; but afterwards to depress the velum.

The *tonsil* or *amygdala* is a congeries of mucous glands, of an irregular figure, somewhat oval, the larger extremity above, placed in a triangular recess between the pillars of the palate, above the side of the base of the tongue, covered internally by the mucous membrane, externally by the superior constrictor; small holes are remarked on its surface; these lead into cells from which the mucus can be expressed; the amygdalæ are very vascular and

secrete a viscid fluid, which being pressed out in the moment of deglutition by the contraction of the surrounding muscles, *serves* to lubricate the alimentary bolus in its passage.

The *œsophagus* appears as the continuation of the pharynx, it differs from it however in structure; the mucous membrane is paler; the muscular fibres are arranged in two laminæ, the external are longitudinal, strong and red, attached superiorly and anteriorly to the cricoid cartilage, and below are lost on the stomach; the internal circular fibres are pale, and cease abruptly at the cardiac orifice of the stomach. In the neck the œsophagus descends posterior to the trachea, and nearly in the middle line; it inclines a little to the left side below, so as to be uncovered by that tube; the left lobe of the thyroid gland, the recurrent nerve, and the inferior thyroid vessels, lie on it in this situation. The course and connections of the œsophagus in the chest will be seen hereafter.*

§ 5.—*Dissection of the Larynx.*

The *larynx* is composed of several cartilages and muscles; it is placed at the anterior part of the neck, between the tongue and the trachea, and in front of the pharynx and œsophagus, it is suspended by muscles and ligaments from the *os hyoides;* this bone is connected to the chin by several muscles, and to the styloid process of the temporal bone on each side by the digastric and stylo-hyoid muscle and ligament; it consists of five parts, the middle portion, or *body*, is very rough and convex anteriorly for the attachment of muscles, concave posteriorly where it covers the epiglottidean gland; from the body the *cornua* pass off, one to either side, giving attachment to muscles above and below, lined by mucous membrane, and serving to expand the pharynx and fauces; where each cornu joins the body, a small process, the *appendix* ascends obliquely backwards, and gives attachment to the stylo-hyoid ligament and muscle. *Use*, to serve as a fixed point for the muscles of the tongue, pharynx and larynx.

Four cartilages enter into the formation of the skeleton of the larynx, the thyroid, cricoid and two arytenoid, and one fibro-cartilage, the epiglottis. The *thyroid-cartilage* is placed at the anterior and lateral parts of the larynx; it presents, anteriorly, a prominence, named in the male subject, the *pomum Adami*, laterally the *alæ*, each of which in passing backwards, increases in depth, and presents an oblique ridge for the attachment of the sterno-thyroid,

* The student should practise the passing of a probe or canula armed with a ligature, along the nares into the pharynx, and endeavor to enclose the uvula in the noose, thus imitating the operation of tying polypi when situated in the pharynx, on the velum, or in the posterior nares: he may also pass a flexible tube into the pharynx, and thence direct it to the stomach or into the larynx; any practitioner may be suddenly called on to use the stomach pump in case of poison having been swallowed, or to inflate the lungs in asphyxia: in the *first case* when the tube has been passed into the pharynx, from the mouth or nares, the tongue should be pressed back, so as to close the glottis, and the end of the instrument should be kept close to the vertebræ to avoid irritating or pressing on the epiglottis: in the *second case*, the tube should be passed through either naris into the pharynx, the forceps or the finger of the surgeon introduced into the mouth, can then guide it downwards and forwards to the glottis; at this time, however, the tongue should be drawn forwards; thus the epiglottis will be raised and the glottis opened opposite the edge of the velum; the tube may then be urged into the larynx, and artificial respiration commenced: in conducting this process it is advisable to press the upper part of the trachea gently against the vertebræ, so as to fix the larynx and the tube, as well as to guard against the admission of air into the œsophagus, and the consequent inflation of the stomach.

and thyro-hyoid muscles; a hole is frequently observed in each ala near this ridge; posteriorly the alæ terminate round and thick, and from their upper and lower extremity send off the processes called *cornua*; the *ascending cornua* are connected to the cornua of the os hyoides by round ligaments, which are often cartilaginous, and even bony; the *inferior cornua* are shorter, and are attached by synovial membranes and capsular ligaments to the sides of the cricoid cartilage; the anterior angle of the thyroid is connected superiorly to the body of the os hyoides by a thin membrane, *anterior hyo-thyroid ligament*, and inferiorly to the cricoid cartilage by a strong elastic ligament, *crico-thyroid.*—The *cricoid*, or annular cartilage, forms the lower part of the larynx, is narrow before, deep behind; the inferior edge or circumference is nearly horizontal; the superior is oblique, leading from above and from behind, downwards and forwards; on its posterior surface is a middle prominent ridge, on each side of which is a depression, filled by the posterior crico-arytenoid muscle; at the upper and back part on each side is a smooth articulating convex surface, on which arytenoid cartilage moves. —The *arytenoid cartilages* are triangular, the base below moving on the cricoid, the apex above inclining a little backwards, and surmounted by a small process, the *appendix*; the internal, or opposed side of each cartilage is flat, the external is rough for the insertion of muscles, the posterior surface of each is concave, and covered by the arytenoid muscle; the anterior is sharp, and connected superiorly to the epiglottis by the aryteno-epiglottidean folds of mucous membrane, which folds form the sides of the glottis, and inferiorly to the angle of the thyroid by two ligaments on each side, called *thyro-arytenoid*, or, *chordæ vocales*; these *arise* from a sharp projection on the fore part of the base of each arytenoid, pass forwards converging, and are *inserted* into the angle of the thyroid; the inferior is tendinous and horizontal, the superior membranous and semilunar: the narrow passage between these ligaments of opposite sides is called the *rima glottidis*; between the superior and inferior ligament of each side is a semilunar fossa called the *sinus* or *ventricle* of the *larynx*. The *epiglottis*, or fibro-cartilage, is anterior to the glottis; it is somewhat of an oval form, connected inferiorly by a stalk-like process to the angle of the thyroid; anteriorly by cellular membrane and by the epiglottidean gland to the os hyoides, also to the tongue by three folds of mucous membrane, the central one of which is called the frænum epiglottidis; posteriorly to the arytenoid cartilages by the folds of mucous membrane, which form the sides of the glottis. The epiglottis stands nearly vertical; it is a little curved forwards at its upper border and along its sides, so that its anterior surface is concave from above downwards, and convex transversely; and its posterior surface is concave from side to side, and convex from above downwards; it is very elastic, and never found ossified, a change which the cartilages of the larynx are prone to undergo: in deglutition the epiglottis is of much *use*; it covers the larynx, and so prevents any foreign substance entering it: during this act the tongue is turned backwards, and the larynx raised forwards; thus the glottis is closed, and the contents of the mouth pass over the epiglottis into the pharynx. The larynx is lined by mucous membrane, which passing from the tongue and pharynx, covers the epiglottis and arytenoid cartilages, forms their connecting folds, descends into the larynx, covers the chordæ vocales, lines the ventricles of the larynx

and is continued down through the trachea and the branches of that tube ; it is but loosely connected to the cartilages above at the glottis, but more closely below ; several mucous glands are connected to it, thus in the aryteno-epiglottidean fold of each side there are small glands called *arytenoid*, and in front of the epiglottis, behind the os hyoides, the *epiglottidean gland* is situated ; this opens by small ducts on the posterior or laryngeal surface of the epiglottis. The openings of the larynx are two, the *superior* or the *glottis*, and the *inferior*, or the *rima glottidis*. The opening of the glottis has been already noticed ; it is immediately behind the tongue and epiglottis, and is of a triangular form, the base anteriorly. The rima glottidis is three quarters of an inch below the glottis ; it is like a slit, being very narrow from side to side, and of a triangular figure, the base posteriorly formed by the bases of the arytenoid, and by the upper and posterior edge of the cricoid ; the apex is anteriorly in the angle of the thyroid cartilage, the chordæ vocales form the sides : below the rima glottidis the larynx enlarges within the cricoid cartilage, and is of a circular figure, and soon terminates in the trachea. The muscles of the larynx are symmetrical, they are found on the front, sides, and back part ; those on the fore part are the thyro-hyoid, and crico-thyroid ; on each side are the thyro and lateral crico-arytenoid, and posteriorly are the arytenoid and posterior crico-arytenoid.

Thyro-hyoideus, broad and flat, *arises* from the oblique ridge on the ala of the thyroid cartilage, ascends a little outwards, and is *inserted* into the lower edge of the cornu of the os hyoides. *Use*, to elevate and draw forwards the larynx beneath the tongue and epiglottis, and so cause the glottis to be closed in deglutition. This muscle is partly covered by the integuments and sterno-hyoid ; it appears like a continuation of the sterno-thyroid.

Crico-thyroideus, inferior to the former, short and triangular : *arises* narrow from the forepart of the cricoid cartilage, ascends obliquely outwards and is *inserted* broad into the lower border of the thyroid. *Use*, to approximate these cartilages, and to draw forward the cricoid. The crico-thyroid ligament occupies the space between these muscles ; they are covered by the sterno-hyoid. Raise the ala of the thyroid cartilage on one side, and the lateral muscles of the larynx will be exposed.

Thyro-arytenoideus, is flat and thin, *arises* from the posterior surface of the thyroid cartilage near its angle : the fibres pass backwards and outwards, expanding over the side of the rima glottidis, and are *inserted* into the anterior edge of the arytenoid cartilage. *Use*, to draw the cartilage forwards and towards its fellow, thereby diminishing the capacity of the rima glottidis ; these muscles can also produce various alterations in the form, position, and degree of tension of the chordæ vocales, which they cover, and they can compress the sinus, or sacculus laryngis. The thyro-arytenoid muscles are considered by some as the principal and most important agents in the production of voice, in consequence of their proximity to the vocal chords, and their capability of producing endless varieties in their condition, causing the vibration in their edges so to differ in intensity and duration, as to produce, from the air passing over them, (to a certain extent only) corresponding varieties of sound or tone.

These muscles are covered by the alæ of the thyroid cartilage ; they lie on the chordæ vocales, and the intermediate sinus ; superiorly, their fibres extend

to an indefinite height in the mucous folds of the glottis, and inferiorly they are connected to the following muscles.

Crico-arytenoideus lateralis, *arises* from the upper edge of the side of the cricoid cartilage; ascends obliquely backwards, *inserted* into the base of the arytenoid. *Use*, to draw that cartilage forwards and outwards, and thus to relax the vocal chords, and enlarge the rima from side to side, but contract it from before backwards. Raise the mucous membrane on the back part of the larynx, to expose the muscles situated there.

Crico-arytenoideus Posticus, strong and flat, *arises* from the depression on the posterior surface of the cricoid; the fibres ascend obliquely outwards, *inserted* by a tendon into the outside of the base of the aryteniod cartilage. *Use*, to draw this cartilage backwards and outwards, so as to enlarge the rima in every direction, as in full inspiration. These muscles lie on the back of the cricoid cartilage, and are covered posteriorly by the pale mucous membrane descending into the œsophagus: these and the crico-thyroid muscles are the dilators of the rima glottidis.

Arytenoideus, fills the interval between the arytenoid cartilages, and is enclosed in a fold of mucous membrane: it consists of *oblique* and *transverse* fibres; the former consist of two or three fasciculi, which pass from the apex of one cartilage to the base of the opposite; the transverse fibres are more numerous, and are attached to the posterior surface of each cartilage. *Use*, to approximate these cartilages, and close the sides of the rima: these, together with the thyro and crico-arytenoidei laterals are the contractors of the rima glottis. In the aryteno-epiglottidean folds, fleshy fibres are sometimes discernible, and have been described as distinct muscles, and named from their situation, *aryteno-epiglottidean* and *thyreo-epiglottidean* or the depressors of the epiglottis. In the human subject, however, these are never sufficiently well marked to merit the appellation of distinct muscles.

The arteries which supply the larynx are derived from the superior and inferior thyroid; the former is a branch of the external carotid, the latter of the subclavian. The laryngeal nerves are four in number, two on each side, the *superior* and *inferior*; both are derived from the par vagum or pneumo-gastric; the former arising from it near the base of the cranium, the latter, on the right side, comes off from this trunk at the lower part of the neck, and on the left side it arises from it in the thorax, below the arch of the aorta: the inferior laryngeal nerves are principally distributed to the muscles, and the superior to the membrane and glands of the larynx, but not exclusively so.

The inferior supply the posterior and lateral crico-arytenoid and the thyro-arytenoid muscles; the superior sends a large branch to the arytenoid, and a small, but very long filament to the crico-thyroid muscle; several branches of this nerve are distributed to the epiglottis, and to the mucous membrane at the glottis, which in this situation possesses great sensibility.

§ 6.—*Dissection of the deep muscles of the neck.*

These muscles lie close to the vertebræ, and are exposed by removing the pharynx, larynx, cervical vessels and nerves.

Longus Colli extends from the third dorsal vertebra to the atlas; it *arises* from the bodies of three superior dorsal and four inferior cervical vertebræ,

from the intervertebral ligaments, also from the head of the first rib, and from the anterior tubercles of the transverse processes of the four last cervical vertebræ; the fibres ascend obliquely inwards, adhering to each bone in their course, and are *inserted* into the forepart of the 1st, 2d and 3d cervical vertebræ. *Use*, to bend the neck to one side, and rotate the atlas on the dentatus; or, if both muscles act, to bend the neck directly forwards. This muscles appears to consist of an inferior and superior portion; the first arising from the bodies of the dorsal is inserted into those of the inferior cervical vertebræ the second arising from the transverse processes of the 3d, 4th and 5th cervical vertebræ, is inserted into the bodies of the 1st and 2d. These muscles, like most of those which adhere to the vertebræ, though long, yet consist of short fibres which pass from one bone to another, are generally intermixed with tendinous substance, and are irregular as to the number of the vertebræ to which they are attached.

Rectus Capitis Anticus Major, long and flat, *arises* by small tendons from the anterior tubercles of the transverse processes of the four last cervical vertebræ; they soon unite in a fleshy substance which ascends obliquely inwards and is *inserted* broad into the cuneiform process. *Use*, to bend forwards the neck and head. This muscle lies behind the carotid artery and sympathetic nerve, and between the longus colli and scaleni. Separate this muscle from its insertion, and we expose the following:

Rectus Capitis Anticus Minor, short and narrow, *arises* from the transverse process of the atlas, ascends inwards, and is *inserted* into the cuneiform process. *Use*, to bend the head forwards and to one side on the atlas: this muscle lies to the outer side, but is in part concealed by the last.

Rectus Capitis Lateralis, very short, *arises* from the transverse process of the atlas, ascends, and is *inserted* into the semilunar ridge or jugular process of the occipital bone. *Use*, with the last muscle it can bend the head forwards or incline it to one side. This muscle is external to that last described; it lies on the vertebral artery, and is covered by the jugular vein.

Scalenus Anticus, *arises* tendinous from the anterior tubercles of the transverse processes of the 3d, 4th, 5th and 6th cervical vertebræ; the fibres descendobliquely forwards and outwards, from a flat muscle, which is *inserted* tendinous into the upper surface of the first rib, near its cartilage. *Use*, to bend the neck forwards and laterally, also to elevate and fix the rib as in inspiration. The phrenic nerve decends on the anterior surface of this muscle; the subclavian vein crosses its insertion; the omo-hyoid and sterno-mastoid lie anterior to it; the subclavian artery and brachial plexus are behind it, and the vertebral vessels separate it from the longus colli.

Scalenus Medius, *arises* from the posterior tubercles of the transverse processes of four or five inferior cervical vertebræ, by small tendinous fibres; these become fleshy, and descendobliquely outwards and backwards, and are *inserted* into the upper surface of the second rib behind the subclavian artery. *Use*, similar to the last. This muscle is covered by the brachial plexus, subclavian artery, and anterior scalenus.

Scalenus Posticus, *arises* from the posterior tubercles of two or three lower cervical vertebræ, descends behind the former, and is *inserted* into the upper edge of the second rib, between its tubercle and angle. *Use*, to elevate the

second rib, to bend the neck to one side, and a little backwards. One or two branches of the brachial plexus sometimes separate this from the middle scalenus, at other times there is no distinction between them, excepting in their insertion; behind the posterior scalenus lie the transversalis and splenius colli, also the levator anguli scapulæ, which muscles cannot be examined at present. We shall next proceed to the dissection of the thorax.

CHAPTER. III.

DISSECTION OF THE THORAX.

§ 1.—*Of the muscles on the anterior and lateral parts of the Thorax.*

Make one incision through the integuments along the clavicle, a second from the upper end of the sternum to the ensiform cartilage, and from this point carry a third towards the shoulder; reflect the integuments and subjacent cellular membrane from within and from below, upwards and outwards, and thus the great pectoral muscle will be exposed, the dissection of which will be facilitated if its fibres be made tense by separating the arm from the side. Beneath the integuments in the female we find the *mammary gland;* this is a conglomerate gland, imbedded in fat, hemispherical, flat posteriorly, convex anteriorly, surrounded by a capsule of condensed cellular membrane, which is loosely connected to the pectoral muscle, and sends processes into the gland to support and connect its several lobules; these last are very soft and pale, almost white; from each of them small ducts arise, which uniting together form larger tubes; these converge towards the root of the nipple, where they expand into sinuses, from which smaller ducts proceed and open on its surface: the skin covering the breast is soft and delicate, and about the centre of it, is the conical projection called the nipple, near the point of which the lactiferous ducts open; the base is surrounded by an areola of a dark color. This gland will be found to differ in structure in different subjects; in some the capsule is indistinct, and the lobules scattered, or more separate than usual; in some it has a redder appearance than in others, and it frequently feels unusually hard or rugged, although free from disease.

Pectoralis Major, flat and triangular, *arises* somewhat tendinous from the sternal half of the clavicle, from the anterior surface of the sternum, fleshy from the cartilages of the third, fourth, fifth and sixth true ribs, and from an aponeurosis common to it and the external oblique muscle; the clavicular fibres descend, the sternal pass horizontally, and the costal ascend obliquely; all pass outwards in front of the axilla towards the humerus, into which they are *inserted* by a flat tendon into the anterior edge of the bicipital groove, and by an aponeurosis into the fascia of the arm; a line of cellular membrane separates the clavicular from the sternal portion; in some cases these appear as distinct muscles. *Use,* the clavicular portion can raise the arm and draw it forward, the sternal can press it to the side, particularly if assisted by the latissimus dorsi, and the costal portion can draw it downwards and forwards: the whole muscle will draw the arm forwards and inwards: if the arm have been rotated outwards, it can roll it inwards; if the arms be fixed, and this pair of muscles act, they will draw the ribs

upwards and outwards, and thus by enlarging the thorax assist in inspiration. This muscle is covered by the skin, platysma and mammary gland, and its insertion is partly concealed by the deltoid; it covers a portion of the sternum and of the true ribs, also the subclavian and lesser pectoral muscles, the thoracic and axillary vessels and nerves. Between the clavicular portion of this muscle and the anterior edge of the deltoid, is a space filled by cellular tissue, the cephalic vein and a small artery. The tendinous fibres of the sternal portions of opposite sides decussate each other, and cover the sternum with a sort of aponeurosis; the insertion has a twisted appearance in front of the axilla, the sternal and costal portions being folded behind the clavicular, and *inserted* superior and posterior to it into the anterior edge of the bicipital groove, while the clavicular is united to the deltoid, and is *inserted* into the humerus along with that muscle; in some subjects a bursa may be found between these two insertions of the pectoral muscle. From the lower edge of the costal portion a fleshy slip sometimes descends and joins either the rectus or external oblique muscle of the abdomen; and in some a strong muscular band connects it to the inferior margin of the latissimus dorsi. Make a perpendicular division of this muscle, reflect the edges, one towards the sternum, the other towards the shoulder; and the lesser pectoral and subclavian muscles come into view.

Pectoralis Minor, flat and triangular, *arises* from the external surface and upper edge of the third, fourth and fifth ribs, sometimes from the second, external to their cartilages; the fibres ascend obliquely outwards and backwards, and converging, end in a flat tendon, which is *inserted* into the inner and upper surface of the coracoid process, near its anterior extremity, being here connected with the coraco-brachialis and short-head of the biceps; a band of this tendon frequently passes over this process through the triangular ligament, and is connected to it, or to the tendon of the supra-spinatus, or to the capsular ligament of the shoulder. *Use*, to draw the shoulder forwards, downwards and inwards, also to assist the great pectoral, in elevating the ribs in inspiration. This muscle is covered by the great pectoral, a few of its inferior fibres are covered only by the skin; it lies anterior to the serratus magnus, axillary vessels and nerves.

Subclavius, small and round, *arises* by a flat tendon, from the cartilage of the first rib, external to the rhomboid ligament, soon becomes fleshy, and ascending outwards and backwards, is *inserted* into the external half of the inferior surface of the clavicle, extending as far outwards as the space between the conoid and trapezoid ligaments. *Use*, to draw the clavicle and shoulder forwards and downwards, also to elevate the first rib in inspiration, if the shoulder and clavicle be raised and fixed. This muscle is covered by the clavicle and great pectoral; it lies anterior to the axillary vessels and nerves, which separate it from the first rib; it is covered by a thin but strong aponeurosis, which is attached to the cartilage of the rib, and to the clavicle and subclavian muscle, from which it passes downwards and outwards to the coracoid process, arching across the great vessels, and is then connected to that process, and to the tendon of the lesser pectoral; this fascia is called by some the *coraco-clavicular ligament*; it is sometimes very strong, and from the manner in which it is extended over the vessels, it renders it difficult to feel the pulsation of the axillary artery below the clavicle.

Serratus Magnus, thin and broad, particularly anteriorly, placed behind the pectoral muscles and the axillary vessels, and between the scapula and the ribs, arises by eight or nine fleshy slips, from the eight or nine superior ribs; the fibres ascend obliquely backwards, and are *inserted* between the subscapular, the rhomboid and levator anguli muscles into the base of the scapula, but particularly into the superior and inferior angles. *Use*, to draw the scapula forwards, particularly the inferior angle, and thus, by rotating this bone on its axis, to raise the acromion process and the shoulder joint: when the upper extremity is fixed, this muscle can raise and draw outwards the ribs, so as to assist in inspiration.—The serratus magnus lies on the ribs and intercostal muscles; also on a portion of the serratus posticus; external to it are the axillary vessels, the scapula and subscapular muscle; the trapezius, latissimus dorsi and rhomboid muscles lie behind it, and the pectoral muscles are anterior to it; an abundance of loose cellular membrane connected to its surface allows it to glide on the ribs, and also facilitates the movements of the scapula upon it. The four superior digitations lie behind those of the lesser pectoral, and the four inferior, which are only covered by the skin, indigitate with the origins of the external oblique. If the clavicle be separated from the sternum, and the scapula pulled from the side, this muscle will then become tense, and in this state it appears to consist of three portions, which differ in structure and in form: the *superior* is a thick, short and strong fasciculus, somewhat square, passing from the two first ribs beneath the axillary vessels and brachial plexus, to the superior angle of the scapula; its flat surface is directed upwards, and lies on a plane anterior to the next or *middle division*, which is very thin, consisting of but few fleshy fibres, connected together by an aponeurosis. This portion is of a triangular form, the apex attached to the 3d and 4th ribs, the base to the basis of the scapula, not exactly to the bone, but to a strong tendinous cord, which extends along this line from the superior to the inferior angle. The third, or *inferior* division of the serratus is the strongest and most extensive; it is radiated or triangular; the apex thick and fleshy, attached to the inferior angle of the scapula; the base thin and expanded on the ribs. The serratus may be again examined when dissecting the muscles on the back of the trunk.

Intercostales, are 22 in number on each side, 11 external and 11 internal;—the *external* commence at the transverse processes of the dorsal vertebræ, *arise* from the inferior edge of each rib, descend in fasciculi obliquely forwards, and are *inserted* into the external lip of the superior edge of the rib beneath, and terminate a little behind the costal extremity of the cartilages: an aponeurosis, the fibres of which run in the same direction, supply their place as far as the sternum. The *internal intercostal muscles* take an opposite direction, and decussate the former; they commence at the sternum, and are discontinued at the angles of the ribs; they *arise* from the inner lip of the lower edge of each cartilage and rib, the fibres, paler and shorter than those of the external, descend obliquely backwards, and are *inserted* into the inner lip of the superior edge of the cartilage and rib beneath. *Use*, both laminæ co-operate to raise the ribs, the first rib being fixed by the scaleni. The intercostal muscles, in elevating the ribs, also evert their lower edges, and twist them at their vertebral and sternal ends, and thus assist in inspiration, by enlarging the chest transversely, and from before backwards. The

internal layer lies on the pleura, and is separated from the external by the intercostal vessels and nerves; the external layer is connected to the pleura only in the space between the angles of the ribs and the vertebræ. At the posterior extremity of the external intercostal muscles there are the following twelve small muscles, which, however, may be seen more fully when the muscles of the back have been dissected.

Levatores Costarum, arise narrow and tendinous from the extremity of each dorsal transverse process, descend obliquely outwards, and are *inserted* broad into the upper edge of the rib beneath, between its tubercle and angle; their name denotes their *use*. They are parallel to, and frequently appear as a portion of the external intercostals; the first levator is short, and arises from the last cervical vertebra; the inferior increase in length and size.

Behind the sternum is a small muscle which cannot be seen until this bone is removed; the dissection of it, therefore, the student may postpone, until he is opening the cavity of the thorax.

Triangularis-Sterni, *arises* from the posterior surface and edge of the lower part of the sternum, and from the xiphoid cartilage; the fibres ascend obliquely outwards, the inferior pass transversely—*inserted* into the cartilages of the 4th, 5th and 6th ribs. *Use*, to depress and draw backwards the cartilages of the ribs, so as to assist in expiration. These muscles lie on the pleuræ, pericardium, and diaphragm, are covered by the sternum, cartilages of the ribs, and mammary vessels. They antagonize the external intercostals, to whose fibres they are parallel, and this explains the cause of the external intercostals terminating at the end of the ribs, and not continuing as far forwards as the sternum. The mechanism of respiration shall be further considered when the diaphram has been examined (see dissection of it). In connection with the muscles of the thorax, the student should study the anatomy of the axilla.

§ 2.—*Dissection of the Axilla.*

The *Axilla*, is a conical cavity, the apex superiorly at the coracoid process and clavicle, the base below, formed by skin and a thick fascia: it is bounded anteriorly by the great and lesser pectoral muscles, internally by the serratus magnus and the ribs, externally by the scapula and subscapular muscle, and posteriorly by the serratus and latissimus dorsi. This region contains several lymphatic glands, vessels and nerves, and a quantity of loose cellular and adipose tissue, which is continued from the neck beneath the clavicle, and often presents a watery reddish appearance. When the pectoral muscles have been divided, and some cellular membrane removed, the *axillary vein* first appears; at the upper part of the axilla this vessel is internal and anterior to the artery; inferiorly it is directly over this vessel, and more closely connected to it than above; this vein receives the cephalic vein, and several branches from the parietes of the thorax, and from the shoulder. The *axillary artery* may be next seen, taking an oblique course downwards and outwards through this space, and giving off thoracic branches from its internal side; and from its external, the subscapular and circumflex arteries; behind the artery, at the upper part of the axilla, the *brachial plexus of nerves* is seen; as this descends it becomes more and more closely connected to it, and at the

lower part of this cavity the branches of the plexus have almost surrounded the artery. The plexus may be seen dividing into several branches; superiorly, it gives off the thoracic, supre and subcapsular; and lower down it divides into the external and internal cutaneous, the median, ulnar, radial or spiral, and articular or circumflex. The general distribution of these branches will be noticed in the dissection of the upper extremity, and for their particular description see Anatomy of the Nervous System. At the lower part of the axilla the artery may be observed in general to lie between the two roots of the median nerve, with the external cutaneous to its outer or humeral side, and with the ulnar and internal cutaneous to its inner or thoracic side, while posterior to it are the musculo-spiral and articular nerves. The lymphatic glands are connected to the axillary vessels by the small branches which supply them: several lie posterior to the edge of the pectoral muscle; from these a chain continues up to the coracoid process, and are continued beneath the clavicle and the glands in the neck; several also lie on the subscapular muscle, and some are scattered indifferently through this space.

§ 3.—*Dissection of the Cavity of the Thorax.*

The thorax is situated at the upper and anterior part of the trunk; it contains the lungs,the organs of respiration, the heart, the chief agent in the circulation of the blood, also several nerves and vessels passing to and from the heart,and through the cavity; this region is bounded anteriorly by the sternum and costal cartilages, laterally by the ribs and intercostal muscles, posteriorly by the vertebræ and angles of the ribs, inferiorly by the diaphragm, superiorly by the several muscles connected to the clavicle, first rib and sternum, and by the different parts passing into or out of the cavity. The thorax, viewed externally, presents a very different form before and after the upper extremities are detached from it; in the former state it appears of great transverse width above, and narrow below; whereas in the latter condition, it is seen to be very contracted above and expanded below. The thorax may be compared to a section of a cone, the posterior fourth being removed, three anterior parts retained and united to each other. The axis of the cavity is oblique from above downwards and forwards; the base of the thorax is also oblique from before, backwards and downwards, and the apex on the contrary is oblique from behind, forwards and downwards; hence the perpendicular diameter of the thorax is much greater posteriorly than it is behind the sternum. The apex of the thorax is somewhat truncated, and presents an oval opening longer transversely than from before backwards; this, the *superior orifice of the thorax*, is bounded anteriorily by the upper edge of the sternum and interclavicular ligament, posteriorly by the last cervical and first dorsal vertebræ, and laterally by the first rib: the several important parts which pass through this opening shall be noticed afterwards. The inferior circumference of the thorax is five or six times more extensive than the superior; it is bounded by the xiphoid, the last true and all the false costal cartilages, and by the last dorsal and first lumbar vertebræ; its longer diameter is also transverse. Open the cavity by dividing the cartilages of the ribs on each side of the sternum, and raising the latter from below upwards; if we look under the sternum as we thus slowly raise it, we perceive that space called *anterior mediastinum*

to be gradually developed, from the right and left pleuræ separating from each other as we tear the loose cellular membrane which naturally connects the pleuræ and pericardium to the posterior surface of the bone: when the sternum is removed this region is fully exposed; it is described as being of a triangular form, the base, the sternum; the sides, the pleuræ, converging behind so as nearly to touch each other; the apex, the small portion of pericardium left uncovered by the pleuræ; naturally, however, all the parts within the thorax are so closely applied to the parietes, that no space or cavity of a defined form, like that assigned to the anterior mediastinum, can truly be said to exist. The dissector, however, may cause this space to appear more distinct by the following precaution: before you divide the cartilages, push your fingers from the abdomen behind the sternum, and break down the cellular connections between it and the pleuræ, then cut the cartilages very near the sternum, and raise the latter; without this precaution before dividing the cartilages, the pleura, particularly the right, will be in almost every instance laid open, and so the appearance of the anterior mediastinum injured. This region in general inclines a little to the left side below, in consequence of the left pleura being more attached to the pericardium, which lies rather to the left of the middle line, whereas the right pleura is connected to the sternum in a vertical line: the anterior mediastinum is wider superiorly and inferiorly than in the centre, hence some compare it to the letter X, and describe it as consisting of two triangular spaces, their apices joined in the centre, the base of one towards the neck, and that of the other towards the diaphragm: the superior portion contains the origins of the sternohyoid and thyroid muscles and the remains of the thymus gland; inferiorly there is much loose cellular membrane, which leads from the neck to the abdominal muscles, also lymphatic glands, and close to the sternum are the mammary vessels, and the triangulares sterni muscles. Next examine the organs on each side of the thorax; these are the lungs and their investing membrane the pleura; in almost all respects these organs are similar on the right and left side, and therefore either may be selected for examination; for this purpose lay open one side, suppose the right, of the thorax, by sawing through the ribs about their centre, and removing their anterior portion; the first rib may be left uninjured; thus the cavity of the right pleura will be opened, its glistening surface seen, with the lung lying collapsed. The *pleuræ* are serous membranes, their internal surface is smooth, polished, and free; their external surface is connected by fine cellular membrane to the parietes of the thorax and to the tissue of the lungs, over which they are reflected. That portion of each which invests the lungs is called *pleura pulmonalis*, and that which is connected to the parietes *pleura parietalis* or *costalis*; the latter portion of the membrane is much more dense and strong than the former; each pleura is a shut sac, and contains only the serous vapor it exhales; for although the lung appears within the cavity, it is yet really external to it or behind it; internally each pleura presents one continuous surface, which can be traced throughout its whole extent; thus we can perceive that the right pleura passes from the back of the sternum to form the side of the anterior mediastinum, and arriving at the fore part of the pericardium is continued along the side of that bag as far back as the root of the lung, whence it is reflected over the anterior surface of this organ, sinking into its fissures, and connecting all its lobules to each other; having thus invested the

whole lung, it arrives at the posterior surface of its root, from which it is reflected to the back part of the pericardium, where it approaches the opposite pleura, to which it is connected by cellular membrane; thence it passes to the sides of the vertebræ, thus forming the side of the posterior mediastinum (to be examined presently); the pleura then expands along the side of the spine, ascending as high as the transverse process of the 6th or 7th cervical vertebra, and descending to the diaphragm, the convex surface of which it covers; on this muscle also it is reflected from the lower edge of the root of the lung by a fold called *ligamentum latum pulmonis*, loose and triangular, the base towards the diaphragm, one side connected to the lung, and the opposite to the mediastinum; from the vertebræ, the pleura continues to pass outwards, lining the ribs and intercostal muscles, as far forwards as the side of the sternum, where the sac was opened, and the description commenced. The pleuræ are of a conical form, the apex of each is in the neck, covered by the anterior scalenus and subclavian artery, the base adheres to the diaphragm; the right pleura is shorter but broader than the left, which is long and narrow; the liver on the right side and the heart on the left, cause these differences to exist; the apex of the right is often higher in the neck than that of the left. The two pleuræ have been resembled to two bladders placed nearly parallel to each other, not having any communication, but touching each other along the mesial line; this juxta-position of the two pleuræ between the sternum and vertebræ forms a sort of partition between the right and left sides of the thorax; this partition is called mediastinum; it consists of course of two laminæ, right and left, connected anteriorly to the sternum, posteriorly to the spine; these laminæ are separated from each other in three situations, in order to enclose certain organs, so that the mediastinum is divided into—1st, the anterior part, or anterior mediastinum, which has been already examined; 2d, into a middle part, or middle mediastinum, containing the heart and pericardium; and 3d, into a posterior mediastinum, which lies in front of the vertebræ, and which the student may next examine.

The *posterior mediastinum* extends in a vertical direction from the 3d to the 10th dorsal vertebra, behind the pericardium and roots of the lungs, and in front of the spine; to obtain a view of the parts contained in it, draw the right lung forward, and to the left side, and make a perpendicular division of the right pleura, between the root of the lung and the spine. This region is described as being of a triangular form, the base posteriorly, the pleuræ forming its sides, and the pericardium its apex; like the anterior mediastinum, however, it has naturally no exact figure, the pleuræ being folded round the organs which lie between them. In the posterior mediastinum we find the œsophagus and 8th pair of nerves, the thoracic duct, vena azygos, descending aorta, splanchnic nerves, several lymphatic glands, and a considerable quantity of fine, loose cellular membrane; the division of the trachea also is enclosed in this space, just at its commencement. The *œsophagus* is anterior to the other parts in the posterior mediastinum; this tube having passed behind the left division of the trachea, enters this space, and descends obliquely forwards behind the pericardium and before the aorta; above, it lies to the right side of this vessel, but below it is to the left; in the lower part of its course it is surrounded by branches of the 8th pair of nerves, and enlarging a little, it perforates the fleshy part of the diaphragm, opposite the 9th or 10th dorsal

vertebra, and joins the stomach. The 8*th pair of nerves* having passed behind the roots of the lungs, attach themselves to the œsophagus, form by their branches a plexus around it, (*the œsophageal plexus*); the left nerve then descends on the fore, and the right on the back part of this tube to the stomach. The *thoracic aorta* enters this region about the 4th or 5th dorsal vertebra, and descends along the left side of the spine; about the 11th or 12th dorsal vertebra it passes between the crura of the diaphragm into the abdomen; in this course the aorta furnishes the following branches; two or three bronchial arteries, which go to the lungs, as many œsophageal branches, and nine or ten pair of intercostal arteries, whose name implies their destination.

The *vena azygos* commences in the abdomen by a small branch from one of the superior lumbar veins, enters the thorax behind the right side of the posterior mediastinum, covered by the right pleura; and opposite the 3d or 4th dorsal vertebra it arches forward over the root of the right lung, and opens into the superior vena cava, as that vessel is entering the pericardium. The vena azygos in this course receives the bronchial, œsophageal, and intercostal veins; those of the left side often unite into one branch, which passing behind the aorta, joins, opposite the 6th or 7th vertebra, the principal trunk on the right side. The *thoracic duct* also commences in the abdomen, on the 2d or 3d vertebra, behind the aorta, in a sinus, called receptaculum chyli: contracting in size it enters the posterior mediastinum along with and to the right side of the aorta; it ascends between this vessel and the vena azygos, imbedded in fat, and opposite to the 5th or 6th dorsal vertebra it attaches itself to the back of the œsophagus, runs obliquely along it, behind the arch of the aorta, to the left side, and ascends in the neck behind the left carotid artery and jugular vein, as high as the 6th cervical vertebra; it then bends downwards and outwards, and enters the left subclavian just before it joins the jugular vein. The coats of the thoracic duct are so fine and thin, that it is often difficult to see or trace this vessel. For a more particular description of it, see the Anatomy of the Absorbent System. The *splanchnic nerves arise* by four or five filaments from the dorsal ganglions of the sympathetic nerve; the first is from the 5th or 6th ganglion, the rest arises in succession below it; all unite and form the splanchnic nerves, which descend obliquely forward on each side of the aorta, along with which they enter the abdomen, where each terminates in a large ganglion, termed *semilunar;* these two ganglions are joined together by numerous branches, which constitute the *cœliac,* or *solar plexus,* from which the greater number of abdominal viscera are supplied with nerves. In the dissection of the posterior mediastinum, the sympathetic nerve is also seen on each side; it does not lie in this space, but descends external to it, between the pleuræ and the heads of the ribs; opposite each intercostal space it forms a ganglion, from which some branches pass to join the dorsal spinal nerves, others to form the great splanchnic; and at the lower part of the thorax two or three filaments often unite to form a small nerve, called *lesser splanchnic,* which enters the abdomen behind or through the crura of the diaphragm, and joins the renal plexus of nerves. The sympathetic on each side enters the thorax close to the neck of the first rib, where it forms a large ganglion; it passes from the cavity by a very small filament, between the crus of the diaphragm, and the psoas magnus, into the abdomen, where it again enlarges considerably. See the Anatomy of the Nervous System.—The

division of the trachea, the last part of any importance connected with the posterior mediastinum, does not, strictly speaking, lie in this space, but like the heart and great vessels, it is in the middle mediastinum, or between the anterior and posterior; this tube can be more conveniently examined afterwards, when we are dissecting the parts which pass through the upper opening of the thorax. Next examine the lungs.

The *lungs* are situated at either side of the spine, and when distended with air, as they always are during life, they so exactly fill each side of the thorax that the pleura pulmonalis and costalis are always in such perfect apposition, that there never can be any intermediate cavity; they are of a conical figure, the apex, above, rises into the neck a little above the level of the first rib, and in general higher on the right than on the left side; the base, below, concave, rests on the diaphragm: the external surface convex, and divided into two or three parts by a deep fissure; the internal slightly concave, and attached near its centre by the root of the heart and great vessels; the posterior edge of each lung is thick, round, and vertical; the anterior is thin, irregular, oblique, and shorter than the posterior; that of the left side is in general notched opposite the apex of the heart. The right lung is broader but shorter than the left, the former consists most commonly of three lobes, the latter has only two The *great fissure* of each lung descends obliquely forwards; it commences behind the apex, and ends in front of the bases; it divides the substance of the lung, to a great depth, in *two lobes*; one is anterior and superior, and the other posterior and inferior; the latter is somewhat larger; on the right side a *small fissure* leads from about the middle of the great one, forwards to the edge of the lung, and cuts off the *middle lobe* from the superior; this fissure does not penetrate to the same depth as the great one does; it is sometimes absent, and in some subjects it exists on the left as well as on the right side. The *root* of each lung is situated a little above the centre of the internal surface, and about two-thirds from the anterior edge; the phrenic nerve and a few filaments of the pneumogastric lie anterior to it, and the pulmonary plexus is posterior to it; the fold called ligamentum-latum is below it; it consists of several vessels and nerves connected together by cellular tissue, and all enclosed between the laminæ of pleura; dissect off this membrane from the fore part of the root, and we shall observe the two pulmonary veins inferior, but anterior to the pulmonary artery, which is immediately above and behind them; posterior and superior to the artery is the bronchial tube; a quantity of cellular tissue connects these vessels, and contains the bronchial arteries and veins, also several nerves, which are derived from the pulmonary plexus. In the root of the left lung the bronchial tube is rather inferior to the artery, but still posterior to it, as on the right side. The lungs have a peculiar soft, emphysematous feel, and are so light as to float in water; their color is gray, interspersed with spots of dark blue or blackish tint; the younger the subject the redder the lungs will be found; in the adult they are generally gray, and slightly streaked with dark lines; in the old they are usually mottled with blue or black spots, which exist, not merely on the surface, but through their substance. The lungs are composed of the ramifications of the pulmonary arteries and veins, of the bronchial arteries and veins, of the pulmonary nerves, of lymphatic vessels and glands, and of the ramifications of the bronchial tubes, which end in numerous air cells; these are collected at first in clusters, and joined

by cellular membrane into lobules: these last are again united into larger masses by the pleura, so as to form lobes; the air-cells are the terminations of the bronchial vessels; they are globular, are lined by mucous membrane and covered by a fibrous, or, as some suppose, a muscular lamina; each bronchus divides into two branches, these again subdivide into two, and so on in binary order; these canals increase in number, and diminish in size; their final capillary branches end in small sacs or air cells; these constitute the principal bulk of the lung: the larger bronchial tubes are composed of the same materials as the trachea, but in the smaller branches there is no cartilaginous structure. On their delicate parietes the fine capillaries of the pulmonary arteries and veins are spread, and here during life is effected that important change in the blood, from venous to arterial, which appears to be the great design of the function of respiration. The soft and yielding tissue of the lungs admits of the free entrance and rapid circulation of the air through their cells, all which become distended in the moment of inspiration; in this act the lungs are wholly passive, the air distending them in the exact proportion with which the parietes of the chest are expanded; in expiration, the contraction of the thorax expels a great portion of the air from the cells, and thus the lungs become diminished in capacity; in effecting this change the elasticity, aided in all probability by the irritable or muscular energy of these organs may assist the muscular and elastic power of the parietes of the chest. In expiration the air-cells are not wholly emptied; no power can completely discharge the air from lungs that have once breathed. See Anatomy of the Diaphragm.—We shall next direct our attention to the pericardium and the heart.

The *pericardium* is a strong fibro-serous membrane, in the form of a conical bag, whose base is below and apex above; it is larger than the heart, which it encloses, together with a portion of the great vessels connected to it, and over whose surface its internal or serous layer is reflected: the external fibrous lamina is connected, inferiorly, to the central division of the cordiform tendon of the diaphragm, and to some of its fleshy portion between the central and the left divisions of that tendon; anteriorly, to the pleuræ, and to the parts contained in the anterior mediastinum; posteriorly, to the œsophagus and to the other parts in the posterior mediastinum; superiorly, it is continued along the outer coat of the great vessels, while the serous layer is reflected on these towards the heart. On each side it is in a similar manner connected to the pulmonary vessels; the pleura and the phrenic nerve also are attached to it in this situation. The connection between it and the tendon of the diaphgram particularly towards its fore part is very intimate; in the adult they are almost inseparable, not so however in the fœtus. Open this bag, and we shall see that it is lined throughout by a smooth serous membrane, which if we trace to the superior part of the sac we shall perceive to be reflected on the vena cava on the right side, on the aorta in the middle, and on the pulmonary artery on the left side; on these three vessels it descends towards the heart: there is a longer portion of the aorta covered by the serous membrane than of the vena cava or pulmonary artery, which two are nearly equal in this respect. The serous layer is reflected on the superior cava, opposite the entrance of the vena azygos; as it descends along that vessel it nearly surrounds it, except a small portion of it posteriorly; from the vena cava it continues to the right auricle, which it covers anteriorly and on the right side; from this it passes on the

right pulmonary veins, covers these partially, and is thence reflected to the fibrous layer; from the lower part of the right auricle it is continued partly round the inferior cava, and from it also it is reflected to the fibrous layer. On the aorta the serous layer decends as first on the forepart, afterwards on its sides and back part, so as to encircle it; near the heart it passes from it over the pulmonary artery, so as to connect these vessels to each other, leaving of course uncovered so much of each as are in apposition; along these vessels the serous membrane decends to the ventricles, and having covered all the anterior surface of the heart, it turns round its apex, covers the posterior surface, and ascending on it as high as the upper edge of the left auricle, it is thence reflected on the fibrous layer in front of the posterior mediastinum; from the left auricle also it extends to the left pulmonary veins, from which it is continued to the fibrous layer, and on this we can trace it in an uninterrupted course to that point, at which we commenced its description.

The pericardium, by its fibrous lamina, is of *use* in fixing the heart in its situations, and strengthening its parietes, so as to resist over distention; this tunic also, by its elasticity, may assist in the subsequent contraction of its cavities, while the serous layer being always lubricated by a fine fluid, facilitates the motion of the heart. When the pericardium is fully opened, the right auricle, the two cavæ the appendix of the left auricle, the right or anterior ventricle, that small portion of the left which forms the apex of the heart, the aorta and pulmonary artery, also branches of the coronary vessels, ramifying on the anterior surface of the heart, all come into view.

The *heart* is placed obliquely between the lungs, the base of it is superior, posterior, to the right side, and near to the spine, while the apex points towards the costal end of the cartilage of the 6th rib on the left side, and during life can be felt pulsating a little above and below this rib; the heart is retained in situ by the pericardium, and by the great vessels; it is subject, however, to a slight change of position, according as that of the body is altered, as well as from the different states of inspiration and expiration. The heart consists of four cavities, two ventricles, and two aurcles; these the student may examine in that order or course which the blood pursues in passing through this organ. Suppose the two venæ cavæ pour their blood into the right auricle so as to distend it, the parietes of this cavity then contract, and empty its contents into the right ventricle; this next propels the blood into the pulmonary artery, the branches of which convey it through the lungs; from these organs it is returned by the four pulmonary veins, two on each side, into the left auricle; from this cavity it is forced into the left ventricle, which then propels it into the aorta, through whose branches it is conveyed to all parts of the body, whence it is again returned to the heart by the veins. The *superior* vena cava is seen descending obliquely forwards and inwards within the pericardium, and joining the upper and back part of the right auricle. Of the *inferior* cava but a short portion is seen within the pericardium; this vessel lies on a plane posterior to the superior cava, and passing obliquely upwards, backwards, and inwards, joins the lower and back part of the right auricle. Between these two veins the *right* auricle is situated; it is somewhat square, its posterior part, between the two cavæ, is called the sinus; the anterior loose portion, the auricular *appendix* or process; the right auricle is connected inferiorily to the right ventricle, and partly rests on the diaphram; on the right side it is free, and on the left it

is connected to the left auricle; lay open this cavity by a perpendicular incision from the superior down to within half an inch of the inferior cava, from the centre of this make a transverse cut towards the anterior part of the auricle, wash out the blood, and we may then observe at the back part of the sinus the *openings* of the *two* cavæ, and between these a slight projection tuberculum Loweri; and in the auricular appendix the muscular fibres called musculi pectinati. We can also now perceive that the left or internal side of the auricle is formed by a thin sheet of membranous and muscular substance; this is the septum auricularum; on the inferior part of this we may observe a depression, the fossa ovalis, immediately above the inferior cava, and surrounded in part by a thick lip, named its annulus; at the upper and deeper part of this fossa we frequently find a small oblique passage leading into the left auricle, its obliquity, however, prevents any communication taking place during life; in the fœtus before birth this was a free opening, the foramen ovale, between the two auricles; anterior to the opening of the inferior cava we observe the semilunar fold of the lining membrane, the Eustachian valve; this valve is connected by its convex edge to the angle between the vein and auricle; its concave edge is loose, and looks backwards and to the right side; its superior cornu is connected to the anterior or the left limbus of the fossa ovalis, and the inferior to the fore part of the vena cava; this cornu is sometimes continued round that vessel to the posterior limbus of the fossa ovalis; in the adult and old this valve is often reticulated and imperfect; in the fœtus it is generally more perfect and large, hence it is considered by many as being of use at that period in directing the blood from the inferior cava at once into the left auricle through the foramen ovale, and preventing its mixing with that from the superior cava. To the left side of the Eustachian valve, between it and the ventricle, is the orifice of the coronary vein, which is also partly covered by a semilunar fold of membrane, the valve which secures this opening against the re-entrance of the blood during the contraction of the auricle; this valve also is often imperfect; on different parts of the auricle small orifices may be often seen (foramina Thebesii); these are probably the extremities of small veins.

In the anterior part of the auricle we see the small circular opening of the appendix, inferior to which, and opposite the tuberculum Loweri, is the large orifice leading into the right ventricle; this, the right auriculo-ventricular opening, is circular, and surrounded by a dense white line, which has been erroneously described as the right tendon of the heart. We may next examine the right ventricle: for this purpose open its cavity, by raising the anterior wall in the form of a flap from below, making one incision along its right side, and the other near the septum cordis. The *right* ventricle is triangular, its base is joined to the auricle, the apex is a little above the apex of the heart; the right is separated from the left ventricle by a thick muscular lamina (the septum cordis): the parietes of this cavity are rendered very irregular internally by numerous muscular projections, the corneæ columnæ; *some* of these are attached throughout their whole length, *others* are fixed by their extremities, and loose in their centre, and a *third* species are fixed by one end to the fleshy substance of the heart, by the other to thin tendinous cords which are attached to the auricular valves; the carneæ columnæ take various directions, and are all covered by the fine lining membrane of the

heart. At the base of this cavity we observe the auricular and arterial opening, the latter is superior, anterior, and to the left side of the former; from the margin of the auricular opening a fold of the lining membrane descends into the ventricle, the inferior loose edge of which divides into three portions, each ending in a very irregularly notched margin, to which the chordæ tendineæ are attached; these are the tricuspid valves, one division is anterior, the second is posterior on the septum cordis, and the third, which is the largest, is to the left side, and separates the auricular from the arterial opening; many of the tendinous threads are connected to the dorsum, as well as to the edge of these folds, and cross each other as they run to the carneæ columnæ. The *use* of the tricuspid valves is to prevent the reflux of the blood from the ventricle into the auricle; as the former cavity is being distended, the blood separates the valves from the parietes of the ventricle, and thus becomes situated on their outer side; when the ventricle then contracts, it presses the blood against these folds, which are thus approximated to each other, and slightly raised against the opening so as to close it, the carneæ columnæ at the same time contracting make tense the chordæ tendineæ, and thus accomplish the two objects, 1st, of completely approximating the valves; and 2d, of preventing their being reversed or thrown up into the auricle. The orifice of the pulmonary artery is small, and situated at the highest point, and at the left extremity of the ventricle, the surface of which becomes smooth as it approaches it; this vessel is connected to the ventricle by the external and internal serous membranes of the heart, between which its fibrous coat is connected to the fleshy fibres of the ventricle by three roots, convex towards the heart, and marked internally each by a distinct white line; from this arterial opening three folds, the semilunar valves, extend into the vessel, the convex edge of each is fixed to the white line at each of the roots of the artery; the concave is loose, but thick, and contains in its centre a small tubercle, the corpus arantii, or sesamoideum. The *use* of these valves is to prevent the blood returning from the artery into the ventricle, for, as the former becomes distended, the blood flows behind these valves, separates them from the sides of the artery, and so approximates them to each other; and when the artery contracts, it presses the blood so strongly against these valves as nearly to intercept the opening, and cause the blood to flow onwards through the artery; the corpora arantii are supposed to be of *use* in giving additional strength towards the centre of the opening, where the pressure will be greatest; the semilunar valves, both in the pulmonary artery and in the aorta, while they support the column of blood in these vessels cannot wholly prevent its regurgitation to the heart. The pulmonary artery ascends obliquely backwards for about two inches and a half within the pericardium; and just as it escapes from this cavity it divides into the right and left branch; in this course it lies at first anterior to the aorta, and afterwards to the left side. The *right* pulmonary artery is the longer branch; it turns in a transverse direction to the right side, and passes through the arch of the aorta, and behind the superior cava, to the root of the right lung, and there divides into three branches. The *left* pulmonary artery is short, proceeds to the left side, and entering the root of the left lung anterior to the left bronchus, divides into two branches; from the division of the pulmonary artery a ligamentous

cord extends backward and downwards to the lower extremity of the arch of the aorta; this is the remains of the ductus arteriosus, which in the fœtus conveyed the blood from the pulmonary artery into the aorta, as it could not pass in any quantity through the condensed structure of the lungs; the recurrent, or inferior laryngeal nerve of the left side winds round this substance. In the lungs the pulmonary arteries divide into numerous branches, which spread minutely on the air-cells, on which they terminate in the pulmonary veins, which vessels thus arise by innumerable ramifications; these unite with each other, and form larger trunks, which arrive at the root of the lungs, two on each side, where they lie anterior and inferior to the pulmonary artery; these veins then pass inwards to join the left auricle, a cavity which may be next examined. The *left* auricle is situated at the upper and back part of the heart, in front of the mediastinum; it may be exposed, either by raising the apex of the heart, or removing this organ from the body, and placing it on its anterior surface; it is somewhat square, smaller than the right, but its parietes are thicker and stronger; from its upper and left extremity its appendix, which is very small, passes forwards, and overlaps the origin of the pulmonary artery; lay open this cavity by a perpendicular incision along its middle line; internally we perceive it smooth, except in the appendix, where a few fleshy fasciculi appear, as in the right side; on the septum auricularum, a slight depression, not so distinct as that in the right auricle, marks the former situation of the foramen ovale; the four pulmonary veins are seen opening into the angles of this cavity, two on each side; those of the left open very near each other, and sometimes in common, beneath the opening of the appendix; at its inferior part we perceive the opening into the left ventricle, circular, smooth, and marked by a white line, as in the right auricula-ventricular opening, than which this of the left side is somewhat smaller. The *left* ventricle is conical; its apex forms the apex of the heart; flattened anteriorly; longer but smaller than the right ventricle; its parietes are much thicker, and to it the septum cordis appears to belong: continue the incision that had been made in the left auricle downwards along the back of the left ventricle to its apex; the great thickness of its walls, and the roughness of its internal surface from the strong and projecting carneæ columnæ, may now be remarked; at the superior part of this cavity we find the auricular and aortic openings; these lie very near each other, the arterial being immediately in front of the auricular: from the circumference of the latter there descends a fold of membrane, which divides into two portions, called the mitral valves; these are stronger, but in every other respect are similar to the tricuspid valves in the right ventricle; these also answer a similar office, that of preventing the blood returning from the left auricle. The aortic opening is situated at the upper and anterior part of the left ventricle, in front of the auricular, from which it is separated by the anterior or large division of the mitral valve; the ventricle is smooth in the vicinity of this opening. The anterior division of the mitral, and the left of the tricuspidal valves are supposed to be larger than the other portions, for the purpose of preventing any blood flowing from the auricle or ventricle into the aorta or pulmonary artery until the ventricle is fully distended. The aorta arises from the left ventricle in the same manner as the pulmonary artery from the right; three semilunar valves also proceed from this orifice into the aorta, stronger, but

similar in structure and in function to those in the pulmonary artery, the corpora arantii in particular are larger and firmer in the aortic valves; external to each semilunar valve, the aorta is dilated into a small sinus; these three are named the sinuses of Morgagni, or lesser sinuses of the aorta. The aorta at its origin is covered by the pulmonary artery; it ascends obliquely forwards and to the right, as high as on a level with the cartilages of the 2d rib of each side; it then passes backwards, and to the left side; and lastly descending as low as the 4th dorsal vertebra, it becomes closely attached to the spine: this portion of the aorta is called the arch, at the termination of which this vessel receives the name of thoracic or descending aorta, which descends through the posterior mediastinum, as was already stated; the arch of the aorta is divided into the ascending, the transverse, and the descending; the first is the longest portion, and in general is so much dilated at the upper part as to have received the name of the great sinus; this ascending portion is within the pericardium, covered at first by the pulmonary artery; it afterwards lies between this vessel and the vena cava; from the commencement of this, the two coronary arteries arise; the middle or transverse portion of the arch lies above the pericardium, and in front of the trachea; from it arise the innominata, left carotid and left subclavian; the descending portion bends behind the root of the left lung, and is connected to the pulmonary artery by the remains of the ductus arteriosus; through the arch of the aorta, the right pulmonary artery, left bronchus and left recurrent nerve pass.

The heart is composed of three tunics: 1st, the reflected serous layer of the pericardium, externally; 2d, the serous membrane which lines the vascular system, internally; and 3dly, between these membranes a lamina of muscular substance: the serous membranes are stronger, but the muscular tunic weaker in the auricles than in the ventricles; the muscular fibres are arranged chiefly in a spiral direction, but they are so closely united that their course is not obvious, unless after long maceration; external to this tunic, in the adult or old, and on the right side principally, we generally find a quantity of adeps placed. The coats of the heart are supplied with blood from the two coronary arteries, the first branches of the aorta: the nerves of the heart are small and numerous, they are derived from the cervical ganglions of the sympathetic, and from the pneumo-gastric of each side. (See Vascular and Nervous Systems.)—The student may next examine what are the parts which pass through the upper orifice of the thorax.

Posterior to the deep cervical fascia we perceive the sterno-hyoid and thyroid muscles first ascending through this opening: behind these is a quantity of cellular membrane, and the remains of the thymus gland: next are the *right* and *left* venæ innominatæ, the former descending perpendicularly, the latter obliquely across this opening; these two veins unite opposite the cartilage of the 2d rib of the right side, and form the superior vena cava, which soon enters the pericardium, and empties itself into the right auricle; behind these veins, the phrenic and par vagum enter the chest; the former is external and anterior to the latter, and both are anterior to the subclavian arteries. The phrenic nerve, accompanied by the internal mammary vessels, descends through the thorax, anterior to the root of the lungs, to the diaphragm, to which it is distributed; this nerve on the left side is longer, and lies somewhat posterior to that on the right side; the 8*th* pair entering the chest, between the subclavian

vein and artery, passes backwards behind the root of the lung, on which it forms an extensive plexus, pulmonary plexus; it then enters the posterior mediastinum, and becomes attached to the œsophagus, which conducts it to the stomach. We next perceive the innominata, left carotid, and left subclavian arteries ascending out of this cavity; the innominata is most anterior, and the left subclavian the most posterior of the three. The trachea is next seen entering the thorax, behind these vessels, and inclining a little to the right side; this tube commences opposite the 5th or 6th cervical vertebra, descends at first in the middle line, but as it approaches the chest, it inclines to the right, aorta pressing on its left side; in the neck it rests on the œsophagus, and lies between the great vessels; it is covered by the thyroid gland and its veins, the sternal muscles, the arteria and left vena innominata: in the thorax, the trachea descends obliquely backwards, and opposite the 3d dorsal vertebra it divides into the right and left bronchial tubes; a number of dark lymphatic glands (the bronchial glands) lie in the angle of the division, and adhere closely to the branches. The trachea is composed of 18 or 20 fibro cartilages, connected together by an elastic substance, and lined by mucous membrane; each cartilage forms about three-fourths of a circle, the deficiency posteriorly being filled by a fibrous membrane, which also encloses the cartilages, and by some transverse muscular fibres and mucous glands; the *right* bronchial tube is the larger branch; it runs transversely into the root of the lung, and divides into three branches; the vena azygos bends over this vessel; the *left* bronchial tube is longer, and takes a course slightly curved downwards and to the left side, through the arch of the aorta to the root of the left lung, and then divides into two branches; the further subdivisions of these two tubes gradually lose the cartilaginous structure, divide into numerous fine membranous vessels, which terminate in small cells; these communicate with each other, and on these the pulmonary vessels minutely ramify: the bronchi are composed of the same structures as the trachea, the cartilages, however, soon lose their annular form, and become irregular; in their minute subdivisions they no longer exist; the air serves to retain these as well as the cells in a permanently distended condition. Behind the trachea, the œsophagus is seen entering the thorax, lying close to the spine; at first a little to the left of the mesial line, afterwards to the right of that line, and as it descends through the posterior mediastinum, it again inclines to the left. On the left side of this tube, the thoracic duct is seen ascending from the thorax into the neck, between the left carotid and subclavian arteries. As the œsophagus enters the chest, we observe on either side of it the recurrent nerve; that of the left side passes out of this cavity, that of the right arises on a level with this opening: external to this nerve, on each side, we perceive the sympathetic entering the chest; it lies posterior to the phrenic and the vagus, but between both; this nerve having formed its inferior cervical ganglion, divides into several branches which descend into the thorax, a few pass anterior to the subclavian artery, the principal pass behind it; they all unite in its first thoracic ganglion, which is situated on the neck of the first rib; the sympathetic then descends along the side of the spine, passing over the heads of the ribs, and opposite each intercostal space forms a small triangular ganglion, from each of which two or three small branches proceed to join the dorsal spinal nerves, and from the five or six inferior the great and small splanchnic nerves arise; the sympa-

thetic is so small, inferiorly, that it is often difficult to trace it; it escapes from the thorax into the abdomen, beneath the true ligamentum arcuatum. Posterior to the œsophagus, the longi colli muscles ascend through the upper opening of the thorax; on each side of these lie the superior intercostal artery, and the anterior branch of the 1st dorsal nerve, ascending to join the last cervical in the brachial plexus.

CHAPTER IV.

§ 1.—*Muscles of the Back.*

Place the subject on the forepart, raise the chest by blocks, let the head and arms hang, thus, the muscles in this region will be made tense: divide the integuments along the middle line, from the occiput to the sacrum; make a transverse incision from the last cervical vertebra to the acromion, and another from the last dorsal vertebra to the posterior part of the axilla; reflect the upper and lower flap of integument from the spine towards the side and raise the middle portion from below upwards and inwards; thus the dissector can most easily expose the trapezius and latissimus dorsi muscles; the integuments in this region are dense, also the subjacent cellular tissue, which seldom contains much adeps, inferiorly it is often anasarcous; when all this is dissected from the posterior part of the trunk, we see exposed the trapezius superiorly, the latissimus dorsi inferiorly, and between these, in a small triangular space behind the base of the scapula, a part of the great rhomboid, also two or three tendons of the sacro-lumbalis, and a portion of the 7th, 8th, and 9th ribs, and of the corresponding intercostal muscles; along the middle line of the neck a strong ligament in observed, (ligamentum nuchæ), at the lower part of which a strong aponeurosis of an oval form (the cervical aponeurosis): also covering the lumbar region another still stronger is seen, (the lumbar fascia): to each of these the student should pay attention. The ligamentum nuchæ is *inserted* superiorly into the occipital protuberance, it descends in the median line, broad above, and sinking in deep, so as to form a septum between the muscles on the right and left sides and is *inserted* inferiorly into the spinous processes of the three or four last cervical vertebræ, and into the cervical aponeurosis. *Use*, to support the thead in flexion of the neck, and to give attachment to muscles. The cervical aponeurosis extends from the 5th cervical to the 5th dorsal vertebra, narrow at each extremity, and broad in the centre between the superior angles of the two scapulæ; the fibres are transverse, and continuous with the fibres of the trapezius on each side: it gives strength to these, and binds down the subjacent muscles. The lumbar fascia is of great strength; it is also somewhat oval, attached by its inferior extremity to the spinous processes of the sacrum, and by its superior to those of the inferior dorsal vertebræ; on either side it is connected to the crest of the ilium, and to the abdominal muscles, particularly to the transversalis, also to the latissimus dorsi and seratus posticus inferior; its internal surface is attached along the median line to the spines of the lumbar vertebræ, and on either side to the transverse processes. This fascia gives great support to the loins, where the skeleton is comparatively weak; like the ligamentum nuchæ it supports the

trunk in flexion, it also assists in maintaining it in equilibrio in lateral motion, and it also serves to give attachment to several muscles, which again in their turn serve to keep it in a state of tension.

The muscles of the back are many of them indistinct and vary very much in different subjects both in their appearance and in their exact attachments to any certain number of vertebræ; the student is not to expect therefore to find each muscle in this region to correspond accurately with the description that is given, some being attached to a greater, others to a lesser number of processes than is stated. The muscles of the back are arranged in *four* successive layers, each nearly covering the other between the integuments and the bones; the muscles of the *first* layer are the trapezius and the latissimus dorsi.

Trapezius, broad, triangular, the base along the spine, the apex at the shoulder, *arises* by a thin aponeurosis from the internal third of the superior transverse ridge of the occipital bone, from the ligamentum nuchæ, and from the spinous processes of the last cervical, and of all the dorsal vertebræ; the superior fibres descends obliquely outwards and forwards; the middle pass transversely, the inferior ascend obliquely forwards; all converge towards the shoulder, and are *inserted* into the posterior border of the external third of the clavicle, and of the acromion process, also into the upper edge of the spine of the scapula. *Use*, to raise and draw backwards the shoulder; the inferior fibres which end in a triangular shaped tendon, which glides over the triangular smooth surface at the commencement of the spine, may draw down the base of the scapula, and thus by rotating this bone will elevate the acromion process and assist the remainder of the muscle in raising the shoulder; the trapezius may also incline the head backwards and to one side. This muscle is covered by the skin only, its origin in many points is continuous with that of its fellow; it covers the splenii, complexi, serratus superior, levator scapulæ, and rhomboid muscles; its anterior fibres are parallel to the sterno-mastoid, in contact with it above, but separated below, by fat, vessels and nerves; in some subjects a band of fleshy fibres unites these muscles above the clavicle.

Latissimus Dorsi is very broad, and also triangular; it covers the greater part of the lumbar and dorsal regions, and extends from these to the inner side of the arm; *arises* from the six inferior dorsal spines, and by the lumbar fascia from all the lumbar spines, also from the back of the sacrum, from the posterior third of the crest of the ilium, and by distinct fleshy slips from the three or four last ribs near their anterior extremity; the iliac and lumbar fibres ascend obliquely outwards; the dorsal, which are much weaker, pass transversely; and the costal are nearly vertical; all converge towards the inferior angle of the scapula, over which they glide, and from which they often derive an additional fasciculus of fleshy fibres; thence the muscle continues to ascend obliquely outwards over the teres major, and near the inside of the arm it twist beneath this muscle to its forepart, ends in a flat broad tendon, which is closely connected to that of the teres, and is *inserted* into the inner or posterior edge of the bicipital groove, anterior and superior to that tendon; a small bursa is usually found between these tendons in this situation. *Use*, to depress the shoulder and arm, to draw the arm backwards and inwards, to rotate the humerus inwards, so as to turn the palm of the hand backwards, also to depress the ribs as in expiration: but if the upper extremity be raised

and fixed, this muscle may elevate the ribs, and so assist in inspiration, as well as in raising the whole, as in climbing.

The dorsal portion of the latissimus dorsi is covered by the trapezius; the remainder of this muscle is superficial, its origin is superior to the glutæus maximus, its anterior edge is connected to the abdominal muscles, the inferior faciculi of the external oblique indigitate with its costal origins; it covers the serratus inferior, the lumbar muscles, and the angle of the scapula; its humeral end forms the posterior fold of the axilla; a fasciculus of fleshy fibres sometimes passes across the floor of this region, and connects the latissimus to the great pectoral muscle; between the angle of the scapula and the humerus this muscle has a twisted appearance, the lumbar and costal fibres being inserted into the upper part of the tendon, and the superior or dorsal portion into its inferior edge; the axillary vessels and nerves lie on this tendon at its insertion, and the bicipital groove is lined by aponeurotic fibres derived from it, and from the tendon of the great pectoral, which are thus united to each other, although previous to this they are separated by the brachial vessels and nerves, and by the coraco-brachialis and biceps muscles. Divide the trapezius and latissimus longitudinally between the spine and the scapula, reflect one portion towards the vertebræ, the other towards the side, and the second layer of the dorsal muscles will be exposed. (In dissecting off the latissimus take care not to injure the serratus inferior, which is very thin, and adheres closely to it.)

The second layer of muscles consists of the rhomboid, levator anguli scapulæ, serratus inferior and superior, and the splenii; a considerable portion of each of these is now seen, although they partly conceal each other.

Rhomboideus is broad, thin, and the most superficial of this layer; it is divided into a superior or minor portion, and an inferior or major; the minor *arises* from the lower part of the ligamentum nuchæ, and from the last cervical spinous process; the fibres run parallel outwards, and a little downwards, and are *inserted* into the base of the scapula, opposite to and above the spine. The major *arises* from the four or five superior dorsal spines; the fibres pass outwards and downwards parallel to the former and are *inserted* into the base of the scapula, extending from the spine to the inferior angle. *Use*, to draw the shoulder backwards and upwards; the inferior fibres also can, by pulling back the inferior angle, rotate the scapula, so as to depress the acromion process. The rhomboid muscles are covered by the trapezius, latissimus, and integuments, and conceal part of the serrati postici muscles.

Levator Anguli Scapulæ, long, and somewhat round, placed at the upper and posterior part of the side of the neck, arises by four on five tendons from the posterior tubercles of the transverse processes of the four or five superior cervical vertebræ; these soon terminate in a fleshy belly, which descends obliquely outwards and backwards, and is inserted into the base of the scapula, between the spine and superior angle; its use is to elevate the whole scapula, if assisted by the trapezius, or to elevate the superior angle alone, and to rotate the scapula so as to depress the acromion, thus co-operating with the lesser pectoral muscle; it is covered by the trapezius; a small portion may be seen superiorly between this and the sterno-mastoid muscle; the tendinous origins have those of the splenius colli behind them, and of the scaleni and rectus capitis anticus major before them. Divide and reflect the rhomboid muscles;

beneath these a quantity of loose cellular membrane is placed, between them and the serratus magnus, to the posterior view of which muscle the student should now attend; he may therefore again peruse the account given of that muscle (see page 55).

Serratus Posticus Superior, *arises* by a thin aponeurosis from the ligamentum nuchæ, and from two or three dorsal spines, forms a thin fleshy belly which ends in three fleshy slips, which are *inserted* into the 2d, 3d, and 4th ribs external to their angles. *Use*, to expand the thorax by elevating the ribs and drawing them outwards. This muscle is covered by the trapezius and rhomboid; it lies on the splenius and the deep layer of muscles; an aponeurosis is continued from it to the inferior serratus.

Serratus Posticus Inferior, arises by a thin tendinous expansion, which is connected through the lumbar fascia to the two last dorsal and two upper lumbar spines; it forms a thin fleshy expansion, which divides into three or four fasciculi, which are inserted into the lower edge of the four inferior ribs anterior to their angles. *Use*, by depressing the ribs it assists the abdominal muscles in expiration; also, by fixing the lower ribs it increases the power of the diaphragm, and by aiding this muscle in enlarging the thorax it assists in inspiration; the two serrati also, by making tense the aponeurosis which connects them to each other, compress and support the deep muscles in this region; reflect from its origin the superior serratus, and we shall see the following muscle.

Splenius, is long and flat, fleshy and tendinous, lying beneath the trapezius, and extending in an oblique direction from below, upwards, forwards and outwards; it is divided into two portions, the inferior, or splenius colli, and the superior or splenius capitis. The splenius colli *arises* from the spines of the 3d, 4th, 5th, and 6th dorsal, ascends obliquely outwards, and is *inserted* by distinct tendons into the transverse processes of the three or four superior cervical vertebræ, behind the origins of the lavator scapular. *Use*, to bend the neck backwards, and to one side. Splenius capitis is larger than the last, superior and internal to which it lies; it arises from the spinous processes of the two superior dorsal and three inferior cervical vertebræ, and from the ligamentum nuchæ; it ascends a little obliquely outwards, and becoming larger, is inserted into the back part of the mastoid process, overlapping the sterno-mastoid, and into the occipital bone, below the superior transverse ridge. *Use*, to bend back the head and when one only acts to turn the head to that side; thus co-operating with the sterno-mastoid of the opposite side.

The splenii capitis muscles diverge superiorly, and the complexi appear between them. Detach the splenii from the spinous processes, and divide the fascia lumborum, and the next layer of muscles will appear; this consists of the sacro-lumbalis, longissimus dorsi and spinalis dorsi, cervicalis descendens, tranversalis colli, trachelo-mastoideus and complexus.

Sacro-lumbalis, Longissimus Dorsi, and Spinalis Dorsi, these three muscles are so closely connected inferiorly as to appear but one mass, and several fibres must be divided in order to separate them from each other. Sacro-lumbalis is the largest of the three; it *arises* from the posterior third of the crest of the ilium, from the oblique and transverse processes of the sacrum, from the sacro-iliac ligaments, and from the transverse and oblique processes of the lumbar vertebrae; it ascends and divides into several long tendons, which are

inserted into all the ribs near their angles. *Use*, to extend the spine, and bend it a little to one side, also to depress the ribs as in expiration. The longissimus dorsi lies internal to the last, and arises in common with it, from the posterior surface of the sacrum and of the transverse and oblique processes of the lumbar vertebræ ascending along the vertebral column, it is *inserted* internally by small tendons into all the dorsal vertebræ, and externally by fleshy and tendinous slips into all the ribs between their tubercles and angles. *Use*, to extend, bend to one side, and support the spinal column. When we separate the sacro-lumbalis from the longissimus dorsi and evert the former, we shall expose five or six small tendinous and fleshy fasciculi which arise from the superior edge of each rib, and ascending are *inserted* into the tendons of the sacro-lumbalis; these are called the musculi accessorii; they are very irregular in number, structure and size. Spinalis dorsi lies between the longissimus dorsi and spine; it arises from the two superior lumbar and three inferior dorsal spines; it ascends close to the spinal column, and is *inserted* into the nine superior dorsal spines: its *use* is similar to the last. These three muscles are covered by the lumbar fascia, and by the two preceding layers. These lumbar muscles in old subjects will be often found soft, weak, and pale, and often blended with a soft fatty substance, so as sometimes to resemble a mass of adipocere.

Cervicalis Descendens, or more properly Ascendens, looks like a continuation of the sacro-lumbalis, internal to which it *arises* by four or five tendons from as many of the superior ribs between their tubercles and angles; these unite in a small fleshy belly, which ascends obliquely forwards and outwards, and is *inserted* by three or four tendons into the transverse processes of the 4th, 5th and 6th cervical vertebræ, between the splenius colli and levator scapulæ. *Use*, to extend the neck, and incline or turn it to one side; it may also assist in inspiration by elevating the ribs.

Transversalis Colli, appears as a prolongation of the longissimus dorsi, internal to which it *arises* by small tendinous and fleshy slips from the transverse processes of five or six superior dorsal vertebræ; the fibres uniting ascend obliquely outwards and forwards, and are *inserted* by small tendons into the transverse processes of three or four inferior cervical vertebræ between the cervicalis descendens and the trachelo-mastoideus; its *use* is nearly similar to that of the last described muscle.

Trachelo Mastoideus lies internal to the last, and external to the complexus; it *arises* by several tendinous bands from the transverse processes of three or four superior dorsal vertebræ, and from as many inferior cervical; ascending a little outward it is *inserted* into the inner and back part of the mastoid process beneath the insertion of the splenius. *Use*, to assist in extending the neck, to bring the head backwards, and to incline and rotate it to one side.

Complexus *arises* from the transverse and oblique processes of three or four inferior cervical, and five or six superior dorsal vertebræ, internal to the transversalis and trachelo-mastoideus; it forms a very thick muscle intersected by many tendinous bands; it ascends a little inwards, and is *inserted* close to its fellow into the occipital bone, between the two transverse ridges. *Use*, to draw back the head, to fix and support it on the spine, also to rotate it, being, in this action, an antagonist to the splenius, and an auxiliary to the

sterno-mastoid of its own side. The complexus is concealed by the trapezius and splenius; its insertion, which is covered by the former only, can be felt and seen through the integuments; it lies on the semi-spinalis colli, the deep cervical artery, and the small oblique and recti muscles. Detach the complexus from the spine and reflect it towards the occiput, and evert towards the ribs the other muscles of this layer, we shall thus expose the fourth layer of the dorsal muscles, which consists of the spinalis or semi-spinalis colli, the semi-spinalis dorsi, multifidus spinæ, inter-spinalis, inter-transversales, and immediately below the occiput, of the recti postici, major and minor, and obliqui capitis, superior and inferior.

Spinalis Colli, *arises* from the extremity of the transverse processes of five or six superior dorsal vertebræ, ascends obliquely inwards, and is *inserted* by four heads into the spinous process of the 2d, 3d, 4th and 5th cervical vertebræ. *Use*, to extend the neck and incline it a little to its own side: this thick muscle fills up the space between the spinous and transverse processes of the cervical and dorsal vertebræ: it lies external to the semi-spinalis dorsi, is overlapped by the longissimus dorsi inferiorly, the complexus superiorly, and the serratus posticus superior in the middle.

Semi-Spinalis Dorsi is similar to the last muscle in form and attachment; indeed they appear as one long muscle, which has been thus rather unnecessarily divided into two, each named from the situation of its principal portion; it *arises* by five or six tendons from the transverse processes of the dorsal vertebræ, from the 5th to the 11th; its fibres ascend obliquely inwards, and are *inserted* by five or six tendons into the extremity of two inferior cervical, and three or four superior dorsal vertebræ. *Use*, co-operates with the last described muscle, in extending the neck, supporting the trunk, and inclining the spine backwards, and to one side: it is situated close to the spine above, and internal to the last muscle; but below, it lies on the outer side of the spinalis dorsi.

Multifidus Spinæ is close to the vertebræ, between the spinous and transverse processes, and is covered by the two last described muscles; it consists of a series of small tendinous and fleshy fasciculi; the *first arises* from the spine of the dentatus, or 2d vertebra, and descending obliquely outwards, is *inserted* into the transverse process of the 3d: thus the succeeding muscles are attached, running obliquely from vertebra to vertebra between their spinous and transverse processes; some fasciculi extend over two or three vertebræ: the *last arises* from the spine of the last lumbar vertebra, and is *inserted* into the false transverse process of the sacrum. *Use*, to support the spinal column, extend it, and incline it to one side, and to rotate one bone upon the other, as far as their articulating surfaces will admit.

Inter-spinales are short muscles, consisting of longitudinal fibres; their name expresses their situation and attachment; between the cervical spines they are more distinct, and appear to be in pairs, right and left, as the spinous processes here are forked; some fibres in the neck deserve the name of supra-spinous muscles, as they pass over these processes, cover and adhere to several of them: in the back they are very indistinct, almost wanting, and in the loins they are much weaker than in the neck, chiefly consisting of ligamentous fibres, with a few muscular intermixed. *Use*, to support and extend the spine.

Inter-transversales consist of longitudinal fibres attached and situated, as their name implies; between the cervical vertebræ these muscles are more strong and distinct, and consist of two planes, an anterior and posterior; between the lumbar vertebræ they are less distinct; and still less so, indeed often wanting, between the dorsal. *Use,* to support the spine on either side, and to bend it laterally. External to these in the back, the levatores costarum muscles are seen, which have been already noticed in the description of the intercostals. Between the occiput and the first vertebræ, the following four pair of muscles are situated.

Rectus Capitis Posticus Major. Triangular; *arises* narrow from the spinous process of the 2d vertebra; ascends outwards, and is *inserted* broad into the inferior transverse ridge of the occipital bone. *Use,* to extend the head, or draw it backwards, also to rotate it and the atlas on the dentatus, co-operating with the splenius of the same side; this muscle is covered by the complexus; its insertion is overlapped by that of the superior oblique.

Rectus Capitis Posticus Minor, also triangular, *arises* narrow from the posterior part of the atlas; passes upwards, outwards and backwards, and is *inserted* broad into the occipital bone, behind the foramen magnum. *Use,* to assist the former in drawing back the head, and steadying it on the spine: this pair is partly covered by the last muscles; a portion of them, however, is seen between these: both the recti resemble the continuation of the inter-spinous muscles.

Obliquus Capitis Inferior, is the strongest of these small muscles; it *arises* inferior and external to the posterior rectus, and superior to the spinalis colli, from the spinous process of the 2d vertebra, ascends obliquely backwards and outwards, and is *inserted* into the extremity of the transverse process of the atlas. *Use,* to rotate the head and atlas on the 2d vertebra, co-operating with the splenius of the same side: and the sterno-mastoid of the opposite side; this muscle is covered by the complexus, trachelo-mastoideus, and trapezius.

Obliquus Capitis Superior, smaller than the last, above the insertion of which it arises, narrow, from the upper part of the transverse process of the atlas, ascends obliquely inwards, overlapping the rectus, and is *inserted* broad into the occipital bone, between its transverse ridges, just behind the mastoid process. *Use,* to bend the head to one side, and draw it a little backwards; any rotatory power it can exert (which must be slight) will oppose the last described muscle. In the dissection of the muscles of this region, but few vessels or nerves of size or note are met with; the arteries which supply these muscles are branches of the occipital and deep cervical superiorly; the posterior branches of the intercostal in the middle, and of the lumbar arteries below; the nerves are the small posterior branches of the cervical, dorsal and lumbar spinal nerves.

CHAPTER V.

DISSECTION OF THE UPPER EXTREMITY.

The upper extremity is connected to the trunk by the sterno-clavicular ligaments, and by ten muscles, of which one is connected to the clavicle (subclavius), one to the humerus (pectoralis major), and eight to the scapula, viz. Trapezius, levator anguli scapulæ, omo-hyoid, rhomboid major and minor, serratus magnus, pectoralis minor, and latissimus dorsi; this last is also inserted into the humerus; all these muscles have been already examined; these the student may divide, then separate the extremity from the trunk, and place a block under the axilla; the dissection of the arm, however, may be performed while it remains connected to the body. The muscles of the upper extremitv are classed into those of the shoulder and arm, forearm and hand.

§ 1.—*Dissection of the Muscles of the Shoulder and Arm.*

Dissect off the integuments from the shoulder and arm as low as the bend of the elbow; beneath the skin and adipose substance is the brachial aponeurosis; this is weak and imperfect in some situations, as on the deltoid muscle; in others it is strong and well marked, and it increases in strength as it descends: it is connected posteriorly to the spine of the scapula, and to the infra-spinatus muscle; inferior to this it receives an addition of fibres from the insertion of the deltiod; internally it is in part continued along the vessels from the fascia of the axilla, and in part also from the tendons of the great pectoral and latissimus dorsi; it invests the whole arm, confining the muscles in their situation, and pressing them towards each other, particularly along the inner side of the arm, so as to overlap the brachial vessels and nerves: as it descends it adheres to the lateral ridge of the humerus, which lead to the condyles; these connections are named inter-muscular ligaments; the *internal* is augmented by a prolongation of the coraco-brachialis tendon, and the *external* by fibres from the deltoid; the fascia of the forearm we shall examine afterwards. Between the integuments and fascia of the arm we notice two cutaneous veins, the cephalic on the outer, and the basilic on the inner side: the cephalic will be found hereafter to commence about the thumb, and to ascend along the radial side of the forearm, and having passed the elbow joint, it is now seen continuing its course up the arm, at first on the outside of the biceps, and afterwards between the deltoid and great pectoral muscles to the clavicle, beneath which it sinks to join the axillary vein; the cephalic vein is unaccompanied by nerves in its course up the arm, but in the dissection of the forearm the external cutaneous nerve will be seen closely connected with it. The basilic vein will be found to commence about the little finger, to ascend along the ulnar side of the forearm, and to pass over the elbow joint; it is now seen continuing its course on the inner side of the biceps, between the skin and facia, and about the middle of the arm it perforates the latter, to join one of the deep brachial veins; in some it continues superficial as high as the axilla, where it joins the axillary vein; the basilic vein in the arm is

accompanied by the cutaneous nerves of Wrisberg, which having escaped from the intercostal branches of the 2d and 3d dorsal nerves, and passed across the axilla, are then distributed to the integuments on the inner side of the arm; inferiorly the internal cutaneous branch of the brachial plexus accompanies this vein, and continues with it along the forearm; dissect off the fascia and cellular membrane from the muscles of the shoulder and arm. The muscles of the shoulder are the deltoid, supra and infra spinatus, teres minor and major, and sub-scapularis, those of the arm are the biceps, coraco-brachialis, brachialis anticus and triceps;—first examine the muscles of the shoulder.

Deltoides, very thick and strong, triangular, *arises* tendinous from the lower edge of the spine of the scapula, and rather fleshy from the anterior edge of the acromion, and of the external third of the clavicle; the fibres converge and descend obliquely, the posterior forwards, the anterior backwards, and the middle at first outwards, and then vertically downwards; *inserted* tendinous into a rough surface, about two inches in extent, situated on the outer side of the humerus, and commencing just above its centre. *Use*, to abduct and raise the arm, the anterior fibres can also draw it forwards, the posterior backwards, and when the arm is by the side, these portions can rotate it inwards or outwards. This muscle can also move the scapula on the arm when the latter is fixed, as in the case of a fall upon the hand or elbow, or in lifting a very heavy weight; under these circumstances this muscle sometimes co-operates with the great pectoral and latissimus dorsi, to dislocate the head of the humerus into the axilla. The deltoid is covered only by the skin, and a few fibres of the platisma; its origin corresponds to the insertion of the trapezius, with which it is often connected by aponeurotic fibres; its insertion is surrounded by the origin of the brachiæus anticus, and lies between the biceps and second head of the triceps; its posterior margin is thin, and sends off an aponeurosis to cover the infra-spinatus muscle; its anterior edge is separated from the great pectoral, by the cephalic vein, some cellular membrane, and a small artery. This muscle is fleshy on its external surface, coarse and rough, and composed of several distinct triangular fasciculi. Divide it transversely, and reflect each portion, and we shall then see that its structure is very complex, and that its internal surface is much more tendinous, a large *bursa* also is seen beneath it; this bursa extends under the acromion, and is expanded on the tendon of the supra-spinatus, and on the capsular ligament; it allows the deltoid muscle and the exterior of the shoulder joint to glide easily against each other; the deltoid also covers the coracoid process, the muscles which are attached to it, all the small muscles connected to the capsular ligament, the insertion of the great pectoral, and the circumflex vessels and nerves.

Supra-Spinatus, fills the fossa of that name, and *arises* from all that portion of the scapula above its spine, which is engaged in forming this fossa, also from a strong fascia which covers the muscle; the fibres pass forwards beneath the acromion process and triangular ligament, end in a tendon which glides over the neck of the scapula (a bursa intervenes); *inserted* into the upper and forepart of the great tuberosity of the humerus, into the most anterior of the three depressions which are marked on that surface. *Use*, to assist the deltoid in raising and abducting the arm, it also strengthens the

capsular ligament, and draws it out of the angle, which is formed by the elevation of the arm, between the humerus and the glenoid cavity; it also presses the head of the humerus and glenoid cavity towards each other, prevents the head of the former from descending out of the latter, and thus it becomes the antagonist to the pectoral, deltoid, and those other long muscles, which have a tendency to dislocate the head of the bone into the axilla. This muscle is covered by the trapezius, much cellular membrane, and fat, and by a strong aponeurosis; its insertion is concealed by the deltoid, and the large bursa beneath that muscle, also by the acromion process and triangular ligament; the tendon is inseparably connected to the capsular ligament.

Infra-Spinatus, is inferior to the last, flat and triangular; *arises* fleshy from the inferior surface of the spine of the scapula, and from the dorsum of this bone, below this process, as low down as the posterior ridge on the inferior costa, also from the aponeurosis which covers it; the inferior fibres ascend obliquely forwards, the superior run horizontally; all converge, and are *inserted* by a strong tendon, which covers and adheres to the outer part of the capsular ligament, into the middle of the external tuberosity of the humerus, below the supra-spinatus. *Use*, to assist the superior part of the deltoid in raising the arm, and drawing it backwards, also in rotating it outwards; when the arm has been raised, its lower fibres can depress it; it will also draw the capsular ligament out of the joint, and strengthen the articulation; it is covered by the trapezius and deltoid; but between these and the latissimus dorsi, a portion of it is superficial. It lies on the bone, and the scapular vessels and nerves; a large bursa lies between its tendon and the neck of the scapula.

Teres Minor, small and narrow, inseparably attached to the last muscle, along the edge of which it runs; it *arises* from a depression between the two ridges on the inferior costa of the scapula, from the fascia which covers it, and from ligamentous septa, which enclose it; the fibres ascend obliquely forwards and outwards, cover and adhere to the capsule, and are *inserted* below the infra-spinatus into the inferior depression on the great tuberosity of the humerus. *Use*, to co-operate with the last muscle. The origin of the teres minor is between and overlapped by the infra-spinatus and teres major muscles; its middle portion is superficial, and its insertion is covered by the deltoid; it lies on the scapula, subscapular vessels, capsular ligament, and long head of the triceps, which last separates it from the teres major.

Sub-Scapularis, is situated on the inner side of the scapula, opposite to the three last described muscles, broad and triangular, the base behind, the apex before; it *arises* from all the surface and circumference of the sub-scapular fossa, the fibres run in thick fasciculi upwards and forwards, and all converge towards the neck of the capsula, over which they glide, beneath the coracoid process, and the muscles which are inserted into it; they end in a tendon which is intimately united to the scapular ligament, and *inserted* into the internal or small tubercle of the humerus; this muscle is covered by the scapula and the muscles of the shoulder; its inferior edge is in contact with the teres major; its internal surface, which forms part of the axilla, is connected to the serratus magnus, and to the axillary vessels and nerves, by loose cellular membrane: a large bursa, very often communicating with the joint, lies between its tendon and the neck of the scapula, beneath the coracoid process: another smaller bursa is sometimes situated lower down, between

the tendon and the capsular ligament. *Use*, this, which is the strongest of these capsular muscles, strengthens the inner side of the articulation, and guards against dislocation when the elbow is suddenly drawn backwards and outwards. This muscle can abduct the arm, draw it backwards, and rotate it inwards, so as to turn the palm of the hand backwards.

These four *capsular* muscles, which have been just described, are of great use to the shoulder articulation; the head of the humerus is so large, the glenoid cavity so superficial, and the capsular ligament so loose and long, that, but for these muscles, the bones could not remain in apposition; hence, in cases of paralysis of the muscles of this region, the joint becomes elongated and flattened, and a partial dislocation exists: in the dissecting room also, if we divide all the muscles surrounding the capsule, and leave the latter uninjured, the bones will no longer be in contact: these muscles, therefore, serve to strengthen the capsule, to keep the head of the humerus pressed against the glenoid cavity, and thus to counteract that tendency to dislocate the head of the bone, which the larger muscles of the limb frequently have, in consequence of their insertion being at such a distance from the centre of the joint, added to the anatomical imperfections in the latter already alluded to; which imperfections, however, are much counter-balanced by the great mobility which the joint enjoys in consequence of this formation, by the numerous opposing muscles which serve to protect the articulation, and by the rotatory motion of which the scapula is allowed to partake.

Teres Major, long and flat, *arise* from a rough, flat surface on the inferior angle of the scapula, below the infra-spinatus; it forms a thick fleshy belly, which ascends forwards and outwards to the inner side of the arm, and ends in a broad, thin tendon, which is at first closely connected to the back of the tendon of the latissimus dorsi; but near the humerus, a small bursa intervenes, and is *inserted* into the inner or posterior edge of the bicipital groove, behind the tendon of the latissimus, and in general, but not always, extending lower down than it. *Use*, to rotate the humerus inwards, and to draw it downwards and backwards; also to draw forward the inferior angle of the scapula; it thus assists the capsular muscles in retaining these two bones in apposition. The origin of this muscle is superficial, the latissimus dorsi sometimes overlaps it; it is here connected to the infra-spinatus and teres minor; from the latter the long head of the triceps afterwards separates it; it passes anterior to this muscle, and assists the latissimus in forming the posterior fold of the axilla. The muscles of the arm are the coraco-brachialis, biceps, and brachiæus anticus anteriorly, and the triceps posteriorly.

Coraco-brachialis *arises* tendinous and fleshy from the point of the coracoid process, and from the tendon of the short head of the biceps; it descends obliquely forwards, and is *inserted*, chiefly tendinous, into the internal side of the humerus, about the middle, and into the ridge leading to the internal condyle, by an aponeurosis, which forms the internal inter-muscular ligament, which is joined to the fascia of the arm. *Use*, to adduct, raise, and draw forwards the arm; also to rotate it outwards. The origin of this muscle cannot be separated from the short head of the biceps, but as it descends, it lies behind, and to the inner side of that muscle; it is covered above by the deltoid and pectoral; a small portion of it below is superficial, and is seen between the biceps and triceps; its insertion is just below that of the teres major, and

separates the brachiæus anticus and posticus: the coraco-brachialis passes over the tendon of the subscapular, latissimus and teres muscles; the brachial artery and median nerve, at first lie to its inner side, but pass superficial to its insertion; the belly of this muscle is generally, but not always, perforated by the external cutaneous, or perforans casserii nerve.

BICEPS, is situated along the fore part of the humerus, and consists of two portions superiorly, the external or long, the internal or short; the *internal arises* tendinous from the coracoid process, between the coraco-brachialis and triangular ligament; it soon becomes fleshy, descends obliquely outwards, and a little above the middle of the humerus is united to the *external* or *long* head, which *arises* by a long tendon, from the upper part of the glenoid ligament of the scapula; this tendon passes outwards to the joint and over the head of the humerus; it then descends into the groove, between the two tuberosities of this bone, in which groove it is bound down by tendinous fibres, continued from the capsular ligament, and from the adjacent tendons; the synovial membrane of the joint is reflected *on* this tendon at its origin, and is again reflected *from* it inferiorly on the parietes of the groove, between the tendons of the great pectoral, latissimus dorsi and teres major muscles; thus, although the tendon passes through the cavity of the joint, it is, strictly speaking, external to the synovial membrane. A little below the middle of the humerus, these two portions of the biceps unite in a large fleshy belly, which descending to within about an inch and a half of the elbow joint, ends in a flat tendon; this sends off a process called the semilunar fascia, to join the general aponeurosis of the forearm, and then sinks below the joint into a triangular hollow between the supinator longus and pronator teres, and is *inserted* into the back part of the tubercle of the radius: a bursa intervenes between this tendon and the anterior part of the tubercle, which is covered by cartilage; the semilunar fascia, which *arises* narrow from the fore part of this tendon, opposite the bend of the elbow, passes upward and inwards, expanding towards the internal condyle, to which, and to the muscles proceeding from it, some of its fibres are attached; the remaining become continuous with the aponeurosis of the forearm. *Use*, to flex the forearm, and make tense its fascia; also, to abduct and raise the arm. When the hand is prone, the first effect of the contraction of the biceps is to roll the radius outwards, and turn the hand supine; the long tendon of the biceps, by passing over the head of the humerus, prevents this bone being dislocated upwards and outwards, as otherwise might occur, in consequence of a fall, or of a sudden muscular contraction: the biceps may also assist the coraco-brachialis, in rotating the scapula on the humerus, so as to depress the point of the shoulder. The long head of the biceps is concealed by the deltoid, supra-spinatus and capsular ligament; the short head, by the great pectoral and deltoid: not unfrequently this muscle has another origin from the humerus below its head; in some a fasciculus unites it to the coraco-brachialis, and in others to the brachiæus anticus muscle, which lies behind it. The belly of the biceps is superficial, and lies on the brachialis anticus: the brachial artery descends along its internal border, and somewhat overlapped by it, in the middle and lower part of the arm. This muscle or its tendon will serve as a guide in the living subject, in case we are required to tie this vessel, but superiorly the coraco-brachialis intervenes: the semilunar fascia is extended over the trunk of this

artery and nerve, and affords them some, but not a constant protection, in the operation of venæsection in the median basilic vein, which vein is superficial to this fascia, but parallel, and often so close to the artery as to expose the latter to some degree of danger in that operation.

Brachialis Anticus, or Externus, improperly called by some Internus, *arises* from the centre of the humerus by two fleshy slips, one on either side of the insertion of the deltoid, from the fore part of the bone down to the condyles, and on each side as far as the intermuscular ligaments; the fibres descend converging, pass anterior to the elbow joint, adhere to the synovial membrane, and are *inserted* by a strong tendon into the coronoid process of the ulna, and into a rough surface on this bone beneath that process. *Use*, to flex the forearm, and in doing so it draws the synovial membrane out of the angle of the joint; it also strengthens this articulation in its extended state, by pressing the ulna against the humerus, and supporting the joint in front: this muscle is covered by the biceps and by the brachial vessels and nerves; external to the biceps it is superficial; its external head is the longer, and lies between the deltoid and second head of the triceps; the internal separates the deltoid from the coraco-brachialis; the tendon passes deep into the hollow at the elbow, behind the tendon of the biceps, and is inserted on its internal side: a fleshy fasciculus often unites this muscle and the biceps about the middle of the arm.

Triceps Extensor Cubiti, covers the back part of the humerus, and extends from the scapula to the olecranon; it consists superiorly of three portions, viz. the middle or long head, the second or external head, and the third or internal, or short head, or brachiæus internus or posticus.

The *long*, or middle head, *arises* by a flat short tendon about an inch broad, from the lower part of the neck of the scapula, and from the anterior portion of the inferior costa; it also adheres to the inferior part of the capsular ligament; it soon ends in a large fleshy belly which decends along the back part of the humerus, that surface which is towards the bone continues tendinous for some distance; about the superior third of the arm it joins the *second* or external head, which *arises* immediately below the insertion of the teres minor, by a narrow tendinous and fleshy slip, from a ridge on the outer side of the humerus commencing below the great tuberosity, and leading down to the external condyle; it also arises from the bone behind this ridge, from the intermuscular ligament, and from the external condyle, by a tendon which passes upwards and inwards, and joins the remainder of the muscle; these inferior fibres are parallel to the anconæus; the *third*, or short head, or brachiæus internus, or posticus, improperly called brachiæus externus, *arises* narrow on the inside of the humerus, above its centre, commencing tendinous just below the insertion of the teres major, and continuing to arise from the ridge which leads to the internal condyle, and from the internal intermuscular ligament; these three portions of the triceps unite above the middle of the arm, and descending along its posterior part, end in a flat broad tendon which consists of two laminæ, a superficial and a deep; the former is continued into the fascia on the back part of the forearm, the latter, which is stronger but narrower, is *inserted* into the olecranon process. *Use*, to extend the forearm on the arm and by its long portion to carry the arm backwards, and in some cases to abduct it; it also draws up the synovial membrane from between the olecranon

process and the humerus, and thus protects it from pressure in the extended state of the limb. The long head gives support to the inferior part of the capsula ligament of the shoulder, and so tends to protect that joint against dislocation, in that situation where it would be most likely to occur. The sudden contraction of the triceps during life sometimes breaks off the olecranon process, and draws upwards the separated portion, of course the individual loses for some time the power of extending the forearm; the fractured piece, however, is prevented being separated to any considerable distance by the aponeurosis of the triceps which covers the olecranon and which joins the fascia of the forearm, and also by the inferior fibres of this muscle, which being connected to the condyles, and having to ascend a little to the olecranon, tend to draw down its fractured portion. The 1st, or long head of the triceps, arises betweeen the two teres muscles; the second, or outer head, below the teres minor; and the third, or the brachiæus internus, or posticus, below the teres major; the long and the second heads are covered abcve by the deltoid, the remainder of them is superficial; the second lies external to the supinator longus and radial extensors of the carpus; the third or internal head is also superficial, and lies between the brachialis antiticus and coraco-brachialis anteriorily, and the long portion of the triceps posteriorly; the ulnar nerve descends along this, and the radial or spiral, separates it from the second or outer head; a small bursa lies between the tendon and the point of the olecranon, a larger one between the skin and the aponeurosis which covers that process; this superficial bursa is peculiarly liable to inflammation, which is generally of an unhealthy character, in consequence, of an injury, such as a fall upon the elbow producing a superficial lacerated wound. In the dissection of the muscles of the arm, we should notice the course of the brachial artery and of its principal branches, also the divisions of the axillary plexus of nerves: the cutaneous veins have been already noticed; the deep veins accompany the arteries, two to each.

The brachial artery which is the continuation of the subclavian and axillary, descends obliquely outwards along the inner side, first of the coraco-brachialis, and afterward of the biceps; near the elbow it inclines forwards, and then sinks beneath the fascia of the biceps, and a little below the bend of the elbow it divides into the radial and ulnar arteries. In this course it is covered by the fascia and integuments, and overlapped a little by the biceps; it is surrounded by a sheath of cellular membrane, which also contains the two venæ comites; the internal cutaneous nerve lies superficial to it; the median or brachial is also superficial to it above, and rather to its outer side, about the middle of the arm, it crosses the artery, and inferiorly it is almost always to its ulnar or inner side. The ulnar nerve lies internal to the artery, and at some distance from it inferiorly; the radial or spiral nerve is posterior to it, and separates it above from the triceps. In this course the artery passes over the tendons of the latissimus and teres, a small part of the triceps, the coraco-brachialis, and the brachiæus anticus. The brachial artery gives off several muscular branches from its external side; and from its internal, the superior profunda, which accompanies the spiral nerve round the back of the humerus to its external side; the inferior profunda which descends along with the ulnar nerve towards the inner condyle, and the

anastomotica magna, which runs towards the inner side of the elbow joint.—See Anatomy of the Vascular System.

The branches of the brachial plexus of nerves, which are met with in the dissection of the arm, are six in number: 1st the *internal* cutaneous, which has been already noticed; 2d, the *external* cutaneous, or musculo cutaneous, or perforans casserii, pierces the coraco-brachialis muscle, descends obliquely outwards between the biceps and brachialis anticus, to which it sends several filaments, and at the anterior edge of the supinator longus it becomes cutaneous, descending along with the cephalic vein and its branches; 3d, the median or brachial nerve accompanies the brachial artery to the bend of the elbow, and sinks beneath the muscles of the forearm, in the dissection of which the remainder of its course will be exposed; 4th, the ulnar nerve descends along the inner portion of the triceps, or the brachiæus internus, runs behind the inner condyle, and is then distributed to the muscles of the forearm and hand; 5th, the musculo-spiral, or radial nerve, descends between the second and third heads of the triceps, and winds round the back part of the humerus, supplying the triceps in its course; it next runs spirally forwards to the forepart of the bone, between the supinator longus and brachialis anticus; it then descends over the forepart of the elbow joint to the muscles of the forearm, where we shall trace it afterwards; 6th, the circumflex, or articular nerve, accompanied by the posterior circumflex artery, passes out of the axilla between the long head of the triceps and the neck of the humerus, winds round the latter beneath the deltoid muscle, to which its branches are distributed.—See Anatomy of Nervous System.

§ 2.—*Dissection of the Forearm and Hand.*

Remove the integuments from the front and back of the forearm and hand, and the investing fascia will be exposed, together with the cutaneous nerves and veins: the latter may be noticed first. The basilic vein is seen to arise by small branches from the sides of the little finger, one of which is named salvatella; it then ascends along the ulnar side of the forearm, receiving in this course small branches from the front and back of the arm, and passing anterior to the internal condyle, it is joined by the median basilic; it then ascends along the inner side of the arm, passes beneath the fascia, and joins one of the deep brachial veins; sometimes it continues in a superficial course to the axilla, and joins the axillary vein. The cephalic vein commences by several small branches about the thumb and back of the hand; it ascends along the radial side of the forearm, passes over the bend of the elbow is joined by the median cephalic, and then ascends along the outside of the arm to the clavicle. The median vein arises by small branches from the forepart of the wrist, it ascends along the forearm between the cephalic and basilic veins, and near the elbow divides into two or three branches: 1st, the median basilic, which ascends obliquely over the fascia of the biceps to join the basilic; 2d, the median cephalic, which passes obliquely upwards and outwards, and joins the cephalic vein; the third branch of the median, when present, sinks deep, and joins one of the deep veins. The internal cutaneous nerve and its branches accompany the basilic vein, some passing

anterior, others posterior to it; the external cutaneous, or musculo-cutaneous, in general lies behind the cephalic vein at the bend of the elbow, its branches afterwards twine around that vessel. The relation between the cutaneous nerves and veins is liable to great variety.

The fascia of the forearm is very strong, particularly on the posterior part; it consists of tendinous fibres, which run in every direction, connected on either side to the condyles, and to the muscles which are attached to these; it receives an addition from the biceps before, and from the triceps behind; as it descends, it invests the limb so closely as to give it a certain form; it sends septa between the different muscles, which give attachment to several fibres, and it adheres very closely to the ulna its whole length; inferiorly it is connected to the annular ligaments of the carpus. The annular ligaments of the wrist appear formed in part by this fascia, strengthened by proper transverse fibres; the *posterior* is attached to the styloid process of the ulna internally, and to that of the radius externally; it binds down the extensor tendons. The *anterior* annular ligament is much stronger; it is attached to the unciform and pisiform bones internally, to the scaphoid and trapezium externally; its upper edge is connected to the fascia of the forearm, its lower to that of the hand: this ligament, together with the carpus, forms a canal or ring for the passage of the flexor tendons. The integuments of the hand are thin posteriorly, and cover several cutaneous veins; anteriorly they are dense, and the subjacent cellular tissue granulated and firm; on the back of the hand a very thin aponeurosis exists, but anteriorly, there is a remarkable strong fascia, the palmar fascia: this is of a triangular form, commences narrow at the annular ligament, from which, and from the tendon of the palmaris longus, it *arises:* it then expands over the palm of the hand, and near the fingers divides into four fasciculi, each of which is forked and *inserted* into either side of each of the sheaths of the flexor tendons, and into the capsular ligaments of the first phalanges; transverse bands pass across these diverging fasciculi, and several fibres penetrate between the tendons, and join the metacarpal bones and interosseous muscles; a thin aponeurosis, derived from the outer edge of the palmar fascia, covers the muscles of the thumb, and a similar one, those of the little finger. Attached to the palmar fascia is the following small cutaneous muscle:

Palmaris Brevis, *arises* from the annular ligament and palmar fascia; the fibres pass transversely inwards, and are *inserted* into the integuments on the inner side of the palm of the hand. *Use,* to deepen the hollow of the palm of the hand by drawing the integuments towards the thumb. We may now dissect off the fascia of the hand and forearm, to expose the muscles; in some situations it is difficult and unnecessary to separate this from the muscular fibres; beneath the palmar fascia we expose the superficial palmar arch of vessels and nerves passing across the flexor tendons and the lumbricales muscles.

The muscles of the forearm are so very numerous, that it will be found convenient to class them according to their situation and their use. One set of these muscles is employed in bending the forearm, wrist, and fingers; these are the flexors: a second, nearly allied to these, have the power of pronating the hand, that is, of rolling the radius across the ulna, so as to make the palm of the hand look downwards; these are the pronators: a third set, the

extensors, can extend the forearm, hand, and fingers; and a fourth, allied to these, the supinators, can turn the hand supine; that is, place the radius and ulna on the same plane, and make the palm of the hand look upwards. The pronators and flexors arise chiefly from the internal condyle, and from the inner or ulnar side of the forearm; each of these two great divisions may be arranged into a superficial and deep layer.

The pronators and flexors arising from the inner side of the forearm, are eight in number: five in the superficial layer, three in the deep; the five *superficial* are, the pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum sublimus, and flexor carpi ulnaris: the three *deep* muscles are the flexor digitorum profundus, flexor pollicis longus, and pronator quadratus. In the following description of these muscles, the hand is supposed to be turned forwards, the radius externally, and the ulna internally. The muscles, which arise from the internal condyle of the humerus, are covered by the fascia of the biceps; they cannot be separated from each other above, but have a common origin from the condyle, the fascia and its septa, also from the ulna.

Pronator Radii Teres, *arises* tendinous and fleshy from the anterior part of the internal condyle, from the fascia of the forearm and its intermuscular septa; also by a small tendon from the coronoid process of the ulna; the median nerve separates these origins; the fibres pass obliquely outwards over the radius, and are *inserted*, chiefly tendinous, into the outer and back part of the radius, about its centre. *Use*, to pronate the hand, by rolling the radius forwards and inwards over the ulna; it is also a flexor of the forearm; this is the most external of the muscles, arising from the inner condyle: it is superficial, except at its insertion, which is covered by the supinator longus, and by the radial vessels, and lies inferior to the supinator brevis: it forms the internal boundary of the triangular hollow at the bend of the elbow, which contains the tendon of the biceps, the brachial nerve and vessels.

Flexor Carpi Radialis, *arises* narrow and tendinous from the inner condyle, and fleshy from the intermuscular septa; it forms a thick belly, which lies very superficial, and ends in a prominent flat tendon; this descends obliquely outwards, passes beneath the annular ligament, and is *inserted* into the base of the metacarpal bone of the index finger. *Use*, to bend the hand, and assist in pronating it; this muscle is overlapped above by the pronator teres, and covered below by the annular ligament; it arises and descends at first between the pronator teres and palmaris longus, afterwards between this latter and the supinator longus, from which it is separated by the radial nerve and vessels; the radial edge of this tendon may serve as a guide, in cutting down on the radial artery in the living subject.

Palmaris Longus *arises* by a slender tendon from the inner condyle, and from the fascia of the forearm; forms a short belly, which ends in a flat tendon; *inserted* near the root of the thumb into the annular ligament and palmar aponeurosis. *Use*, to bend the hand and make tense the palmar fascia; it descends between the flexor carpi radialis and ulnaris, and lies on the flexor sublimis: it is sometimes wanting.

Flexor Carpi Ulnaris, *arises* tendinous from the internal condyle, tendinous and fleshy from the inner side of the olecranon process; the ulnar nerve separates these origins; it also arises by a tendinous expansion from the inner edge of the ulna nearly its whole length, and from the fascia of the forearm,

the fibres pass obliquely forwards to a tendon which descends in front of the ulna, and which overlaps the ulnar nerve and vessels, and is *inserted* into the pisiform bone, and by a few ligamentous fibres into the base of the fifth metacarpal bone; this insertion is also connected to the muscles of the little finger. *Use,* to flex the hand, and adduct it, particularly when assisted by the extensocarpi ulnaris: adduction of the hand, is not so limited as abduction, in consequence of the ulna being shorter below than the radius. This muscle is superficial, and lies internal and rather posterior to the preceding muscles; it descends between the flexor sublimis and extensor carpi ulnaris, and lies upon the flexor profundus; the tendon passes over the annular ligament, and is connected to it by a tendinous slip, which also passes over the ulnar artery and nerve.

Flexor Digitorum Sublimis Perforatus, *arises* tendinous and fleshy from the internal condyle and internal lateral ligament; tendinous from the coronoid process, and fleshy from the radius below its tubercle, internal to the pronator teres, and between the supinator brevis and flexor pollicis longus; it forms a large muscle, which ends in four tendons; these descend, two anterior, for the middle and ring finger; and two posterior, for the index and little finger; they all pass beneath the annular ligament, and proceed along the palm of the hand, superficial to the deep flexor tendons, and beneath the palmar fascia; and at the first phalanx of each finger, or opposite the head of each metcarpal bone, each of these tendons becomes enclosed in a strong sheath, with one of the deep flexors; this sheath is continued to the anterior extremity of the second phalanx. Near the end of the first phalanx, each of the superficial flexor tendons is split for the passage of the tendon of the deep flexor, which is continued on to the last or *ungual* phalanx; while the divisions of each of the superficial tendons become everted or folded out, beneath the deep flexor, so as to lie nearer to the bone, and are *inserted* into the anterior part of the second phalanx. *Use,* to flex the second joint of each finger on the hand, the hand on the forearm, and the latter on the arm. The origin of this muscle is partly concealed by the three first described muscles, which arise from the internal condyle, and to which it is connected by the intermuscular septa; inferiorly a portion of it is superficial between the flexor carpi ulnaris and palmaris longus. The tendons of this muscle are enveloped in a large bursa behind the annular ligament; this *carpal bursa* is connected anteriorly to the annular ligament, posteriorly to the carpus, is expanded around the superficial and deep flexor tendons, the median nerve, and the tendon of the flexor pollicis longus, and ends above and below in a cul de sac, each end of which extends beyond the edges of the annular ligament. In the palm of the hand the tendons of the flexor sublimis are covered by the integuments, palmar fascia, and the superficial palmar arch of vessels and nerves; along the fingers each tendon is enclosed in a strong fibrous sheath, which is continued to the end of the second phalanx of each finger; this sheath, together with the anterior surface of the phalanges, forms a complete canal, or tube, which, half fibrous and half osseous, is lined by a synovial membrane, which forms a *cul de sac* at either extremity; being reflected over the tendons it encloses, and forming several folds of fræna to connect these tendons to this canal: this sheath is weak, opposite each articulation, but is very strong on the phalanges; its anterior extremity is continuous with the insertion of the

deep flexor tendon. Divide the flexor sublimis and carpi radialis, and the three deep muscles will be partially exposed,—namely, the flexor digitorum profundus, flexor pollicis longus, and nearly concealed by these, the pronator quadratus.

Flexor Digitorum Profundus Perforans, *arises* fleshy from three superior fourths of the anterior surface of the ulna, and from the internal half of the interosseous ligament; it sometimes receives a small slip from the radius below its tubercle; it forms a thick muscle which descends along the middle and ulnar side of the forearm, and ends in four flat tendons; these pass beneath the annular ligament, enter the ligamentous sheaths on the fingers, pass through the slits in the superficial flexor tendons, and are *inserted* into the last phalanx of each finger. *Use*, to bend the last phalanx, and to co-operate with the superficial flexor muscle; this muscle is covered by those of the superficial layer, which have been described; the ulnar vessels, the median and ulnar nerves also descend along it; and it covers the ulna, the interosseous ligament and vessels, the pronator quadratus and the carpus, and on each finger its tendon is superficial to that of the flexor sublimis.

Flexor Pollicis Longus, *arises* from the fore part of the radius, commencing narrow just below its tubercle, and ending within about two inches of the carpus, and also very frequently by a long and narrow tendinous and fleshy slip from the coronoid process; this at first looks like a distinct muscle; all the fibres descend obliquely forwards to a tendon, which passes beneath the annular ligament, then runs outwards between the two portions of the short flexor, and the two sesamoid tubercles at the extremity of the metacarpal bone; it then enters a strong ligamentous sheath, and is bound down by it as far as the last phalanx of the thumb, into the middle of which it is *inserted*. *Use*, to flex and adduct the different joints of the thumb upon the hand, and the latter upon the forearm. This muscle is covered by the flexor sublimis and radialis, and by the radial vessels, and inferiorly by the annular ligament, it descends along the radial side of the flexor profundus.

Pronator Quadratus, is exposed by separating the flexor pollicis and profundus; it is situated just above the carpus, and *arises* tendinous and fleshy from the inferior fifth of the anterior surface of the ulna; the fibres pass transversely outwards, descend a little, and are *inserted* into the anterior part of the inferior fourth of the radius. *Use*, to roll the radius over the ulna, and so to pronate the hand: this muscle is covered by the tendons of the preceding, and by the ulnar and radial vessels, and it lies on the interosseous ligament, the radius and the ulna.

The muscles which are situated on the outer and back part of the forearm are supinators and extensors, and are also arranged into two layers, a superficial and deep; the superficial consists of seven, namely, supinator radii longus, extensor carpi radialis longus, and brevis, extensor digitorum communis, extensor minimi digiti, extensor carpi ulnaris and anconæus; these muscles arise more distinctly than those on the internal side of the arm: some of them, however, particularly those on the back part, are closely connected to each other, arising in common from the external condyle of the humerus, from the posterior surface of the radius and ulna, the intermuscular ligaments and the fascia, which is partly derived from the tendon of the triceps.

Supinator Radii Longus, forms the prominence along the outer and

anterior part of the forearm, *arises* tendinous and fleshy from the external ridge of the humerus, commencing a little below the deltoid, and continuing to within about two inches of the outer condyle; it also arises from the inter-muscular ligament, which separates it from the second or outer head of the triceps, between which and the brachiæus anticus this muscle is situated. The supinator longus descends along the outer and anterior part of the elbow, and about the middle of the forearm ends in a flat tendon, which descends along the radius, and is *inserted* into a rough surface on the outside of that bone, near its styloid process. *Use*, to roll the radius backwards, so as to make the hand look supine; it can also bend the elbow joint. This muscle is superficial; it passes over the extensor carpi radialis longus above, the tendon of the pronator teres in the middle, and the radius inferiorly; its tendon descends at first between the pronator teres and extensor radialis longus, afterwards between the latter and that of the flexor carpi radialis: at its insertion it is crossed by the extensor tendons of the thumb. This muscle and its tendon overlap the radial nerve and vessels; its ulnar edge, therefore, will serve as a guide to the latter, in case we are required, during life, to expose them, in order to tie a ligature around the radial artery.

Extensor Carpi Radialis Longus, *arises* tendinous and fleshy from the ridge on the external side of the humerus, between the supinator longus and the external condyle; it passes over the outside of the joint, ends in a flat tendon, which descends along the outer and back part of the radius, runs through a groove on its lower extremity, and passing over the wrist joint, is *inserted* into the back part of the carpal end of the metacarpal bone of the index finger. *Use*, it extends the wrist, bends the hand backwards, and abducts it a little; it may also assist in bending the elbow joint; it is covered by the last muscle, but projects behind it; the tendon passes beneath the extensors of the thumb and the annular ligament; it covers the supinator brevis and the following muscle.

Extensor Carpi Radialis Brevis, *arises* tendinous and fleshy from the inferior and posterior part of the external condyle, and from the external lateral ligament, descends along the back part of the radius, ends in a flat tendon, which runs through the same groove as the tendon of the last muscle, beneath which it lies; passes also beneath the annular ligament, and is *inserted* into the carpal extremity of the third metacarpal bone. *Use*, similar to that of the last; it is covered superiorly by the last described muscle, and by the supinator longus, and below by the tendons of the extensor muscles of the thumb, and by that of the last muscle, and by the skin; it covers the supinator brevis and the insertion of the pronator teres.

Extensor Digitorum Communis, is situated more towards the back part of the forearm than the last described muscles; it *arises* in common with the last, and with the following, from the external condyle, the fascia, and its intermuscular processes, also from the ulna; it descends, and about the middle of the forearm ends in four tendons, which pass under the annular ligament in a groove in the radius, extend along the back of the hand, expanding as they approach the four fingers, into the phalanges of which they are *inserted* by a tendinous expansion. *Use*, to extend all the joints of the fingers: this muscle arises between the extensor carpi radialis brevis and extensor ulnaris; it descends superficially between these, and over the supinator brevis and

extensors of the thumb; on the back of the hand the tendons are connected to each other by cross slips; that which goes to the ring finger is the largest; all the tendons, as they approach the base of the first phalanx, become thick but narrow; afterwards they enlarge and are joined by the tendons of the lumbricales and interossei; at the articulation of the first and second phalanx each divides into three bands; the middle one is inserted into the posterior surface of the second phalanx; the lateral pass along the sides of this articulation; they afterwards converge and unite in a flat tendon, which is inserted into the base of the last or third phalanx. The back part of all the fingers is covered, as far as the last phalanx, by a tendinous expansion, derived from these tendons, and from those of the lumbricales and interossei muscles.

Extensor Carpi Ulnaris, *arises* tendinous and fleshy between the extensor communis and anconæus, ftom the external condyle, fascia and intermuscular septa; descends obliquely inwards, between the flexor ulnaris and extensor communis, towards the ulna, and receives an addition from it; it ends in a strong tendon, which runs through a groove on the back of the ulna, beneath the annular ligament, and is *inserted* into the carpal end of the fifth metacarpal bone. *Use*, to extend the hand and bend it backwards; also to adduct it.

Anconæus, small, triangular, and placed at the outer side of the olecranon, beneath the skin; *arises* narrow and fleshy from the posterior and inferior part of the external condyle, forms a thick triangular mass, which adheres to the synovial membrane and descends obliquely inwards, to be *inserted* into the external surface of the olecranon, and about the superior fifth of the posterior surface of the ulna. *Use*, to extend the forearm on the arm, and to raise the synovial membrane out of the articulation: this muscle is partly covered by the tendon and aponeurosis of the triceps; the remainder of it is superficial; it is situated between the olecranon and the extensor carpi ulnaris; it often appears as a continuation of the triceps; it covers the articulation of the elbow and a portion of the supinator brevis.

Extensor Minimi Digiti, *arises* in common with the last, and descends between it and the extensor carpi ulnaris; it forms a small fleshy belly, which descends very obliquely inwards, and ends in a slender tendon; this passes through a separate groove in the radius, and also through a distinct division of the annular ligament, in which situation it is frequently found divided into two, which continue in contact, and afterwards unite; this tendon becomes attached to the fourth tendon of the extensor communis, and is *inserted* along with it into the posterior part of the phalanges of the little finger. *Use*, to assist the extensor communis.

The deep muscles in this situation will be exposed, by removing the superficial layer; they consist of the supinator radii brevis, three extensors of the thumb, and the indicator.

Supinator Radii Brevis, short and flat, surrounds the upper part of the radius, *arises* from the external condyle, external lateral and coronary ligaments, and from a ridge on the outer side of the ulna, which commences below its lesser sigmoid cavity; the fibres adhere to the capsular ligament, and descend obliquely outwards and forwards round the upper part of the radius, and are *inserted* into the upper third of the external and anterior surface of this bone, from above its tubercle down to the insertion of the pronator teres *Use*, to turn the radius outwards, so as to make the hand look supine. This

muscle is covered by the supinator longus and radial extensors of the carpus externally; by the anconæus and extensor ulnaris posteriorly; and anteriorly by the radial nerve and vessels, and by the brachiæus and biceps; it partly surrounds the humeral and ulnar articulations of the radius; its anterior edge is notched above for the insertion of the biceps, and is overlapped by the pronator teres below.

Extensor Ossis Metacarpi Pollicis, or Abductor Pollicis, *arises* fleshy from the middle of the posterior part of the ulna, below the anconæus, also from the interosseous ligament and posterior surface of the radius below the supinator brevis; it descends outwards and forwards, and ends in a tendon, which passes through a groove on the outside of the lower end of the radius, runs by the side of the carpus, and is *inserted* in general by two tendons, one into the os trapezium, and the other into the upper and back part of the metacarpal bone of the thumb. *Use*, to extend the first joint of the thumb, and separate it from the fingers; it also extends the wrist, and abducts the hand; it can also assist in supination. The origin of this muscle is concealed by the extensor communis and carpi ulnaris; the tendon is superficial, and passes over the tendons of the common extensor, and of the radial extensors of the carpus, also over the radial vessels.

Extensor Primi Internodii Pollicis, or Extensor Minor, *arises* from the back part of the ulna, below its middle, and from the interosseous ligament and radius; it descends along the radial side of the last muscle: its tendon passes through the same groove in the radius, and bound down by the same portion of the annular ligament, and is *inserted* into the posterior part of the first phalanx; a small slip is often continued on to the second phalanx. *Use*, to extend the second joint of the thumb, and to assist the last described muscle; its connections are also similar.

Extensor Secundi Internodii Pollicis, or Extensor Major, *arises* from the posterior surface of the ulna above its centre, and from the interosseous membrane; its belly overlaps the two former muscles, its tendon passes along a distinct groove in the radius, runs over the outer side of the wrist, the metacarpal bone and first phalanx of the thumb, and is *inserted* into the posterior part of the second or last phalanx. *Use*, to extend the last phalanx of the thumb upon the first, and to assist the former muscles in extending and supinating the hand. The tendon of this muscle is separated from the two former, on the outer and back part of the wrist, by a considerable interval, in which we perceive the tendons of the radial extensors of the carpus, and the radial artery; the relations of this muscle in other respects are nearly similar to those of the other extensors of the thumb.

Extensor Indicis, or Indicator, *arises* from the middle of the posterior surface of the ulna and interosseous membrane; its tendon passes under the annular ligament along with those of the common extensor, is attached to the radial side of that tendon which belongs to the forefinger, and is *inserted* along with it into its 2d and 3d phalanges. *Use*, it assists the common extensor, or produces the extension of the forefinger alone, as in pointing. This muscle is concealed by the extensor communis and ulnaris, lies to the ulnar side of the extensor pollicis major, and its tendon passes under those of the common extensor. Next dissect the muscles of the hand: first, those in the palm, which consist, externally, of the muscles of the thumb; internally, of those

of the little finger, and in the middle of the lumbricales superficially, and the anterior interossei, deep seated. The short muscles of the thumb are the abductor pollicis, opponens pollicis, flexor pollicis brevis, adductor pollicis, and abductor indicis.

Abductor Pollicis, *arises* broad and thin from the anterior part of the annular ligament, os naviculare and trapezium, *inserted* into the outside of the base of the 1st phalanx, and by an expansion into both phalanges, its name implies its *use*, to separate the thumb from the finger; it lies superficial, and is most external of these small muscles.

Opponens Pollicis, or Flexor Ossis Metacarpi, *arises* from the annular ligament and os naviculare; *inserted* into the anterior extremity of the metacarpal bone of the thumb. *Use*, to approximate the thumb to the fingers; it is internal to and overlapped by the last muscle; it lies on a part of the annular ligament, and of the following muscle.

Flexor Pollicis Brevis, consists of two portions, between which is the tendon of the flexor longus; one head, the *external* or *anterior arises* from the inside of the annular ligament, and from the trapezium and scaphoid bones, passes outwards, and is *inserted* into the external sesamoid bone and base of the 1st phalanx of the thumb; the 2d, or *internal* or *posterior arises* from the os magnum, and the base of the metacarpal bone of the middle finger; it also passes outwards, distinct from the other at first, but afterwards united to it, and is *inserted* into the internal sesamoid bone, and base of the 1st phalanx. *Use*, to flex the first phalanx and metacarpal bone on the carpus: this muscle is concealed by the two former, and by the first lumbricalis; it covers the two first interossei muscles, and the tendon of the flexor carpi radialis; its outer edge is connected to the opponens pollicis, and the internal to the adductor.

Adductor Pollicis, triangular and broad, *arises* fleshy from three-fourths of the anterior surface of the third metacarpal bone, the fibres pass outwards over the second metacarpal, and converging are *inserted* into the inner side of the root of the first phalanx of the thumb, along with part of the last muscle; its name denotes its *use*. This muscle at its origin is covered anteriorly by the deep flexor tendons and by the lumbricales; its insertion is covered by the following muscle, which may be best seen from behind.

Abductor Indigis, also triangular, *arises* tendinous and fleshy from the metacarpal bone of the forefinger, and from one half of that of the thumb: its fibres extend obliquely inwards and forwards, end in a tendon which passes by the outer side of the first joint of the forefinger, and is *inserted* into the outer side of the base of its first phalanx. *Use*, to separate the forefinger from the others, or to adduct the thumb. This muscle is superficial posteriorly; anteriorly it is covered by that last described: the radial artery passes between its two heads or origins; this muscle is similar to, and may be regarded as one of the posterior interossei, like these also, its insertion joins that of the common extensor tendon. In the middle of the palm of the hand are seen *four* small muscles.

Lumbricales, *arise* from the outer side of the tendons of the flexor profundus, near the carpus, a little beyond the annular ligament; they each form a small fleshy belly, which ends in a tendon; this runs along the radial side of the finger, joins the tendon of the corresponding interosseous muscle, and is *inserted* about the middle of the first phalanx into the tendinous expansion

which covers the back part of each finger. *Use*, to assist in bending the first joint of the finger; they cannot act unless the flexors are tense; they can also adduct and abduct the fingers, and when the common extensor muscle is in action, they may assist in extending them; these small muscles are covered by the superficial flexor tendons, palmar vessels and nerves: the first is the largest, the fourth the smallest; the two middle run nearly parallel, but the internal and external diverge; the tendons of the lumbricales frequently divide into two portions; one of these will be *inserted* into the first phalanx, the other into the posterior tendinous expansion. On the inner side of the palm of the hand are the three following muscles, which belong to the little finger.

Abductor Minimi Digiti, *arises* fleshy from the annular ligament and from the pisiform bone; its fibres run along the ulnar side of the metacarpal bone, and are *inserted* tendinous into the ulnar side of the 1st phalanx; its name implies its *use;* it is superficial; a few fibres of the palmaris only cover it; its origin is partly continuous with the insertion of the flexor carpi ulnaris.

Flexor Brevis Minimi Digiti, *arises* from the annular ligament and unciform bone, *inserted* by a round tendon into the base of the first phalanx of the little finger. *Use*, to flex and adduct the little finger; it lies to the radial side of the last muscle, along with which it is inserted.

Adductor, or Opponens Minimi Digiti, *arises* internal to the last, and overlapped by it, and is *inserted* into all the metacarpal bone of this finger: its name denotes its *use.*

When all the flexor and extensor tendons have been removed, we observe the intervals between the metacarpal bones to be filled by muscular fibres, which are called the interosseous muscles; they are divided into two planes, a posterior and an anterior. The Interossei Antici, or Interni or Palmares are four in number; they *arise* from the sides of the metacarpal bones, and are *inserted* into the first phalanges, and into the tendinous expansion which covers the dorsum of each finger: the 1st or prior, or externus indicis, *arises* from the radial side of the second metacarpal bone, and is *inserted* into the external side of the first phalanx of the forefinger. *Use*, to abduct the forefinger; the 2d or posterior, or internus, or adductor indicis, *arises* from the ulnar side of the second metacarpal bone, and is *inserted* into the inner side of the first phalanx of the forefinger; 3d or prior, or externus or adductor annularis *arises* from the radial side of the fourth metacarpal bone, and is *inserted* into the external side of the first phalanx of the ring finger. *Use*, to draw the ring finger towards the thumb: the 4th, or abductor minini digiti *arises* from the radial side of the fifth metacarpal bone, and is *inserted* into the outside of the 1st phalanx of the little finger. *Use*, to draw the little finger towards the thumb.

The Posterior Interossei, are seen on the back part of the hand; they are longer than the anterior: they each *arise* by two sets of fibres from the opposed sides of two metacarpal bones, and are *inserted* into the base of the first phalanx of each finger, and into the posterior tendinous expansion: the 1st, or prior, or externus medii, *arises* from the second and third metacarpal bones, fills the space between these two, and is *inserted* into the outer side of the base of the 1st phalanx of the middle finger. *Use*, to draw the middle finger towards the thumb: the 2d, or externus medii is situated between the

metacarpal bones of the middle and ring finger, and is *inserted* into the inner side of the first phalanx of the middle finger. *Use*, to draw the middle towards the ring finger; the 3d, or externus annularis, is between the 4th and 5th metacarpal bones; and is *inserted* into the inner side of the ring finger. *Use*, to draw the ring finger inwards. All these muscles can also extend the fingers. Some consider the dorsal interossei as four in number, making the *abductor idicis* the first of this class.

In the dissection of the forearm and hand, we meet with the branches of the brachial artery, with their accompanying veins; also branches of the brachial plexus of nerves; the cutaneous veins have been already noticed. The brachial artery, when it arrives at the head of the elbow, divides into its radial and ulnar branches. The *radial artery* descends from the elbow obliquely outwards, to the styloid process of the radius, passes over the outer side of the carpus and then between the metacarpal bones of the thumb, and of the forefinger, where it divides into three branches, radialis indicis, magna pollicis, and palmaris profunda: the radial artery at first lies between the pronator teres and supinator longus; afterwards between the supinator and flexor carpi radialis; it then winds round the carpus, over the external lateral ligament, and beneath the extensor tendons of the thumb; in the forearm it is only overlapped above by the supinator longus; in the rest of its course it is superficial; it is accompanied by two veins, and by the radial branches of the muculo-spiral nerve, which lies to its outer side. The radial artery gives off, 1st, The recurrent branch, which ascends in front of the external condyle, to supply the muscles attached there, and to inosculate with the superior profunda; 2d, in its course down the forearm, several musclar branches; 3d, near the wrist, the superficialis volæ, which passes to the small muscles of the thumb, and communicates with the superficial palmar artery; 4th and 5th, branches to the fore and back part of the carpus: and between the thumb and index finger it divides into its three last branches; the magni pollicis subdivides, and supplies the sides of the thumb; the radialis indicis, in like manner, supplies the forefinger; and the palmaris profunda passes beneath all the flexor tendons across the four metacarpal bones, forms the deep palmar arch, and then joins a branch from the ulnar artery. The *ulnar artery* is larger than the radial; it descends obliquely inwards, beneath the superficial flexors and pronators, and lies on the flexor profundus; it passes over the annular ligament into the palm of the hand, and there divides into a superficial and deep branch: this vessel is covered above by several muscles, inferiorly it is superficial, and lies between the tendon of the flexor sublimis and flexor carpi ulnaris; it is attended by its two veins, and in the inferior two-thirds of the forearm by the ulnar nerve, which always lies to its ulnar side; near the wrist this nerve is somewhat behind the artery. The ulnar artery sends off 1st and 2d its recurrent branches, the anterior, small, ascends in front of the internal condyle, the posterior, large, passes behind that condyle and joins the inferior profunda; 3d, the interosseous artery, which passing backwards, divides into its posterior and anterior branch; the posterior passes through the upper part of the interosseous space, and ascends in the substance of the anconæus; the anterior interosseous descends between and beneath the flexor profundus and flexor pollicis as far as the pronator quadratus, where it terminates; 4th, muscular branches; 5th and 6th, to the back and front of the carpus; and in

the palm of the hand it terminates in the deep and superficial branch; the former sinks between the muscles of the little finger, to join the deep palmar arch; the superficial runs across the flexor tendons, forming the superficial arch, from the convex side of which, the long digital arteries arise; these supply the three inner fingers. (See Vascular System.)

In addition to the cutaneous nerves already noticed, we find the median, ulnar and musculo-spiral decending in the forearm; the *median nerve* passes between the heads of the pronator teres, and descends beneath the flexor sublimis, giving off the anterior interosseous nerve, and branches to the muscles of the forearm; it passes beneath the annular ligament, appears superficial in the palm of the hand near the thumb, and sends off digital branches, which accompany the digital arteries to all the fingers, except the little and the ulnar side of the ring finger. The *ulnar nerve* winds round behind the internal condyle, between the heads of the flexor carpi ulnaris, and descends along the internal side of the ulnar artery to the hand, where it terminates, by dividing into a small superficial and a large deep branch. The *musculo-spiral* or *radial nerve* is seen beneath the supinator longus, decending along the outer side of the radial artery, and supplying the adjacent muscles; near the elbow it gives off the posterior interosseous nerve and a little below the middle of the forearm it passes beneath the tendon of the supinator, and becomes cutaneous, being distributed to the integuments of the thumb and back of the hand. (See Anatomy of the Nervous System.)

CHAPTER. VI.

DISSECTION OF THE ABDOMEN.

§ 1.—*Of the Muscles on the Anterior and Lateral Parts of the Abdomen.*

Divide the integuments from the sternum to the pelvis, from the crest of the ilium on each side to the umbilicus, also from this point upwards and outwards on each side over the cartilages of the 9th and 10th ribs, as high as midway between the axilla and the border of the thorax; dissect of the flaps; the subcutaneous cellular membrane will be found dense and strong, so as to have received the name of superficial fascia; this may be removed along with the integuments from the superior and lateral parts of the abdomen, but inferiorly and anteriorly it may be suffered to remain for further examination, a knowledge of its structure and connections being of practical importance in the disease of hernia. The *superficial fascia* is continued from the surface of the thorax, over the abdominal muscles; weak and thin above, it increases in density as it descends; from the abdomen it extends on either side over Poupart's ligament to the thigh, which it invests, and in the centre over the organs of generation; in the male a process of it passes round the spermatic cord on each side, decends into the scrotum, and is continuous with the facia of the perinæum, and from the linea alba a thick portion runs to the dorsum of the penis, invests this organ, and serves as a suspensory ligament to it. In the female it is loaded with fat in this situation, and descends into the labia. As this fascia passes over Poupart's ligament, it is connected to it, through the medium of a thin but dense membrane, which ascends from the

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fascia lata of the thigh, and is soon lost on the abdominal muscles; to this the superficial fascia is attached, so as to give the latter the appearance of adhering to Poupart's ligament, although it really is not so. About an inch below this ligament, in the groin, the superficial adheres intimately to the fascia lata; in this situation the former is very thick and laminated, forming capsules for the inguinal lymphatic glands, and is connected to the facia lata by vessels and nerves which perforate the latter in their course to and from these glands, the superficial fascia and integuments; the facia lata here also is very weak, and rather cellular, so that the superficial and deep fasciæ are continuous or identified in this situation; soon afterwards, however, they become distinct. The superficial fascia is thinner along the sides than it is on the forepart of the abdomen; its cutaneous surface is cellular, and closely connected to the integument; its posterior surface is more compact and smooth; several blood vessels ramify between the skin and this membrane; three set on each side, viz. the external circumflex ilii, external epigastric and external pudic arteries; these all arise in the groin, from the femoral artery, or from some of its branches, and ascend over Poupart's ligament; the first ramifies towards the anterior spineous process of the ilium; the second, which is the largest of the three, ascends towards the umbilicus, and the third passes transversely towards the pubis; these several arteries supply the integuments, and inosculate with the deep seated vessels of the same names; they are each accompanied by one or two veins, which are often found remarkably tortuous. The superficial fascia supports and connects the fleshy and tendinous fasciculi of the abdominal muscles; it also possesses a good deal of elasticity, which assists these muscles in the contraction of the parietes of the abdomen. Remove the integuments and facia from the surface of the abdominal muscles, and continue the dissection as far back as within two or three inches of the spine. In dissecting the external oblique muscle at its upper and anterior part, care must be taken not to raise its aponeurosis, which is so thin, as it passes over the anterior part of the thorax, that it may be mistaken for condensed cellular membrane. In order to expose the external oblique muscle, make its fibres tense by putting a block under the loins, and dissect in a line nearly parallel to its fibres; to clean the posterior portion, the subject should be turned a little to the opposite side. The abdominal muscles consist of five pair, viz. obliqui externi and interni, transversales, recti, and pyramidales.

Obliquus Externus, or Descendens, broad, thin, and somewhat square, extends over the anterior and lateral parts of the abdomen, fleshy above and behind, tendinous before and below; it *arises* by eight or nine triangular fleshy slips; sometimes there are only seven, from the eight or nine inferior ribs, at a little distance from their cartilages; the five superior indigitate with corresponding portions of the serratus magnus; and the three inferior with those of the latissimus dorsi, by which they are a little overlapped. The superior fibres are thin, aponeurotic, and weak, and pass horizontally inwards; a tendinous and fleshy slip often connects this portion to the great pectoral muscle: the middle are the longest, and descend obliquely forwards and inwards: the posterior are strong and fleshy, and descend almost vertically: the superior and middle fibres end in a broad tendon, which commences at a little distance external to the linea semilunaris; this tendon is continued over the forepart of the abdomen, covers the rectus muscle, and is so broad

inferiorly as to extend from one spine of the ilium to that of the opposite side; it is very strong inferiorly, but so very thin above, where it covers the thoracic portion of the rectus, that the inexperienced dissector often removes it along with the integuments. The external oblique is *inserted* tendinous into the ensiform cartilage, linea alba, pubis, Poupart's ligament which is formed by this tendon, and into the anterior superior spinous process of the ilium, also tendinous and fleshy into the outer edge of the two anterior thirds of the crest of the ilium. *Use,* to depress the ribs, and compress the abdominal viscera, so as to assist in expiration, and in the evacuation of the urine and fæces. When both muscles act, they can bend the trunk forwards; if one only act, it will bend it to that side, and it may also rotate it to the opposite side. This muscle is covered by the skin and superficial fascia, its posterior border is sometimes overlapped by the latissimus dorsi; in some cases, however, these muscles do not meet, and a small part of the internal oblique is seen in the triangular space between them. On the dissected tendons of this pair of muscles, we may remark the following particulars: the linea alba and umbilicus, lineæ semilunares, linæ transversæ, the external abdominal or inguinal rings, and Poupart's ligament on each side. The *linea alba* is a dense ligamentous cord, extending from the ensiform cartilage to the upper part of the symphisis pubis; it is formed by the intimate union, or by the crossing of the tendinous fibres of the muscles of opposite sides; its greatest breadth is at the umbilicus, from this to the pubis it decreases; its superior portion is much broader than its inferior: the integuments are more closely connected to this line, than they are at either side; hence the more fat the subject, the more indented will the skin appear along it. About the centre of the linea alba is the *umbilicus*; this, in the fœtus, was a foramen, through which were transmitted the umbilical vein from the mother, and the umbilical arteries and the urachus from the child: before the integuments were removed, this spot appeared depressed, particularly if the subject has been very fat; it now projects, and seems formed of very dense cellular tissue, surrounded by, and connected to the adjacent tendinous fibres.

The linea alba serves as a fixed point for the oblique and transverse muscles on either side, also as a ligament to connect the thorax to the pelvis, and to support the former when bending the trunk backwards so as to resist or prevent too forcible extension of the spine. In the inferior part of this line some practitioners recommend the following operations to be performed: puncturing the bladder in case of retention of urine; pracentesis, or tapping of the abdomen, in case of ascites; and the superior operation for lithotomy.

The inferior fourth or fifth part of the linea alba is sometimes deficient, as also a portion of the muscles on each side; so that the urinary bladder is superficial, and constantly exposed: in such cases the anterior part of this viscus also is usually wanting, and therefore its cavity and the orifices of the ureters can be perceived during life.

The *linea semilunaris* extends from the tuberosity of the pubis on each side upwards and outwards, about four inches from the linea alba, towards the cartilages of the 8th and 9th ribs; it appears white, and somewhat depressed, and is formed by the tendon of the internal oblique, dividing at the edge of the rectus into two layers, to enclose this muscle in a sort of sheath. In the living subject this line may be traced by taking the point midway

between the umbilicus and the anterior superior spinous process of the ilium, and from it drawing one line towards the tuberosity or spine of the pubis, and another towards the cartilage of the 9th rib. The operation of tapping ovarian dropsy should always be performed here; and this situation is also selected by some as the best for performing paracentesis in case of ascites. In this last mentioned disease, however, this line is not exactly midway between the umbilicus and spine of the ilium, but half an inch nearer the latter.

The *lineæ transversæ* are three or four in number, and cross the rectus muscle from the linea alba to the linea semilunaris; they are tendinous intersections of that muscle, which adhere so intimately to its sheath, as to give to the latter this indented appearance. These lines will be again noticed in the dissection of the rectus; they are much better marked in some than in others: during life they are very distinct when the abdominal muscles are in strong action. Between the linea alba and semilunaris on each side many small holes are often to be observed in the tendon of the external oblique: they are only for the transmission of small vessels and nerves: they are generally of a square form, and are much larger and more numerous in some than in others. External and superior to the pubis on each side we may always remark the opening called the *external inguinal* or *abdominal ring*, transmitting in the male subject the spermatic vessels and cremaster muscle, and in the female the round ligament of the uterus. This opening is of a triangular form, the base at the pubis, the apex is superior and external; the sides are called the pillars of the ring, one of which is superior, internal, and anterior; the other or Poupart's ligament, is inferior, external, and posterior: the first, or superior pillar, is broad, and inserted into the symphysis and into the opposite pubis; some fibres are continuous with the fascia lata of the opposite thigh; this pillar decussates with that of the opposite side, on the forepart of the pubis, and both send fibres to the dorsum of the penis; the inferior pillar is the internal or pubic portion of Poupart's ligament: the apex of this opening is rounded by a series of fibres, which serve to connect the pillars to each other. These fibres arise from Poupart's ligament at a little distance from the spine of the ilium, pass in curved lines upwards and inwards across the upper part of the ring, and are lost on the surface of the tendon; they serve, by preventing the separation of the sides of the ring, to protect this part of the abdomen against a protrusion of its contents. These fibres are in some cases so closely connected, as to merit the name of a fascia (the *intercolumnal fascia*); this, in old cases of hernia, has been found of great strength, and prolonged for some distance on the hernial sac, and intimately connected with the cremaster muscle; it is this fascia, or these intercolumnal bands, that obscure this opening in many cases, and deprive it of that defined figure usually mentioned by writers, or delineated in plates; the tendon of the external oblique is alone concerned in the formation of the external abdominal ring, there being no corresponding deficiency in the internal oblique or transverse muscle; the spermatic cord, or round ligament, must therefore take an oblique course to arrive at this opening; this will be seen in the next stage of the dissection.

Poupart's or *Fallopius' ligament* or the *crural arch*, is the inferior thickened edge of the tendon of the external oblique; it is very strong, and when the

lower extremity is extended, and the foot and toes everted, it appears very tense; if we consider it as a distinct ligament, it may be described as having an attachment to, or as *arising* from the anterior superior spinous process of the ilium, and thence descending obliquely forwards and inwards to the pubis, into which it is *inserted* by two attachments, one anteriorly into the tuberosity of spine; the other posteriorly into the linea innominata of the pubis, or the commencement of the linea ileo-pectinea: the 1st or iliac end of Poupart's ligament is broad and continuous above, with the tendon of the oblique, and below with the fascia lata; the anterior portion of the pubal end or the *second* insertion, is distinct and round, and can be felt through the skin; it lies behind the cord, and is connected to that portion of the fascia lata which covers the adductor muscles; the posterior pubal attachment or the *third* insertion, also called *Gimbernaut's ligament,* is broad and thin, and lies superior, posterior, and external to the former; it may be seen by raising the cord out of the external ring, and everting Poupart's ligament a little; it is of a triangular form, the apex is anterior towards the tuberosity or spine of the pubis; the base is external and posterior, somewhat crescentic, looking towards the femoral vessels; to it some fibres from the outer or iliac part of the fascia lata are attached, so as to elongate it in this direction: this third insertion of Poupart's ligament forms the internal boundary of the femoral ring, and is therefore concerned in the anatomy of femoral hernia, as will be seen hereafter. Poupart's ligament owes much of its strength to its connection with the fascia lata of the thigh, as may be seen at present, also to its attachment to the fascia transversalis and iliaca, which will be exposed in a future stage of the dissection. Poupart's ligament is of *use* in strengthening the inferior part of the abdomen, and affording a fixed point of attachment to the deeper muscles and to the different aponeuroses; it also protects the great femoral vessels and nerves in their passage from the abdomen to the thigh, and its third insertion partly fills up the internal portion of the crural arch. From this third insertion, and from the pubis, a band of fibres may be observed to pass upwards and inwards behind the superior pillar of the ring towards the linea alba; these assume in general, a triangular shape, and have received the name of the *triangular ligament or fascia*; the base is inferiorly at the linea ileo-pectinea; the apex is superior and internal towards the linea alba, and is continuous with the external oblique tendon of the opposite side: this fascia serves to protect the abdomen in this region. Raise the external oblique, by dissecting off its serrated origins from the ribs, detach also its insertion from the crest of the ilium, and from the internal oblique muscle, cleaning, at the same time, the surface of the latter; throw the external oblique towards the opposite side, separating it as far forward as its connections will permit, that is about half an inch internal to the linea semilunaris; divide its tendon transversely from the spine of the ilium, towards the lower third of the rectus, about an inch above the external ring, thus preserving Poupart's ligament and the external ring for further examination, in relation to the anatomy of hernia. When the external oblique is raised, we see the inferior ribs, the inferior intercostal muscles, the internal oblique, and the cremaster.

Obliquus Internus, or Ascendens, is also situated at the anterior and lateral part of the abdomen, broader before than behind, and more fleshy below than above; it *arises* tendinous, but soon becomes fleshy, from the fascia

lumborum, from all the crest of the ilium, and from the external third or fourth of Poupart's ligament, the fibres diverge in a radiated manner; those from the lumbar fascia and posterior part of the ilium ascend obliquely forwards; those from the anterior part of the ilium pass transversely, and those from Poupart's ligament descend obliquely inwards; the fibres continue fleshy further forward than those of the external oblique; at the linea semilunaris they end in a flat tendon, which at the edge of the rectus divides into two layers to enclose this muscle; the anterior is united to the tendon of the external oblique, the posterior and thinner layer is joined to the tendon of the transversalis; about midway between the umbilicus and the pubis, the tendon of the internal oblique does not divide, but the whole passes in front of the rectus, along with the tenon of the transversalis, to which it is closely connected; a little above the pubis these two tendons are inseparably joined, and are called the *conjoined tendons*. The internal oblique is *inserted*, tendinous and fleshy into the cartilages of the seven inferior ribs, tendinous into the ensiform cartilage, and into the whole length of the linea alba; the conjoined tendons are *inserted* into the symphisis and upper edge of the pubis, and passing external to the rectus are also inserted into the linea innominata, where they are connected with Gimbernaut's ligament, and inseparably joined to the fascia transversalis; these conjoined tendons lie posterior to the spermatic cord and to the triangular ligament, and afford much security to that part of the abdomen behind the external abdominal ring. *Use*, of the internal oblique muscle, to assist the external oblique in expiration, and in compressing the abdominal viscera, also in bending the trunk forwards, or to one side; it can also rotate the trunk, but in doing so, it co-operates with the external oblique of the opposite side; this muscle is covered by the latissimus dorsi; it lies on the transversalis muscle: some small vessels ramify between them; a small portion of the internal oblique is sometimes superficial, between the external oblique and latissimus dorsi, and above the posterior part of the ilium. Along the inferior border of this muscle we observe the following:

Cremaster, consists of a fasciculis of pale fleshy fibres, which *arise* from the internal surface of the external third of Poupart's ligament, and from the lower edge of the last described muscle; a few fibres also sometimes proceed from the lower edge of the transversalis muscle; it frequently too has a tendinous attachment to the pubis, behind the external abdominal ring; the fibres all pass downwards and forwards around the spermatic cord, but chiefly along its outer side, and are *inserted* into the tunica vaginalis; a few fibres are lost in the scrotum. *Use*, to support, compress, and raise the testicle and the vessels; the origin of this muscle is covered by the tendon of the external oblique, and lies on the fascia transversalis: a small but long nerve, a branch from one of the lumbar nerves, runs between its fibres; the lower part of the muscle is superficial and very pale; in cases of old hernia, the fibres of the cremaster are found greatly increased in thickness, and in that form of the disease called the oblique, or common inguinal hernia; this muscle always forms one of the coverings of the sac. The cremaster is absent in the female. Raise off the internal oblique from the transversalis muscle; commence above the anterior part of the crest of the ilium, where the muscles are separated by cellular membrane, and some branches of the circumflex-ilii vessels, make one incision from the ilium towards the cartilage of the 9th rib, and another from

the ilium, towards the lower third of the linea semilunaris; carefully dissect off the posterior part of the muscle, towards the spine, and the anterior towards the rectus; this portion can be separated from the transversalis, a little beyond the linea semilunaris.

Transversalis, somewhat square, broader anteriorly than posteriorly, *arises* tendinous from the fascia lumborum and the posterior part of the crest of the ilium, fleshy from the remaining anterior part of the crest, and from the iliac third of Poupart's ligament; it also arises tendinous from the two last ribs, and by fleshy slips from the inner side of the five succeeding; these indigitate with the origins of the diaphragm; all the fibres pass transversely forwards, except the most inferior, which are curved a little downwards; they all end in a flat tendon, which, near the linea semilunaris, joins the posterior lamina of the internal oblique, and is *inserted* along with it into the whole length of the linea alba, into the upper edge of the pubis, and into the linea innominata; this tendon passes behind the rectus superiorly; but inferior, that is, about midway between the umbilicus and the pubis the conjoined tendons pass anterior to this muscle, and are *inserted* in the manner before mentioned. The transversalis abdominis is covered by the internal and external oblique; it lies on the fascia transversalis and the peritonæum. *Use*, to compress the abdominal viscera, and assist in expiration; this muscle is tendinous before and behind, fleshy in the middle, also above and below, contrary to the two oblique muscles; the posterior tendon is described by some, not improperly, as dividing into three layers; the posterior, very strong, is continuous with the fascial lumborum; the middle, thinner and weaker, is attached to the transverse processes of the lumbar vertebræ, and is separated from the former by the lumbar muscles; and the anterior lamina, which is the weakest, is expanded over the quadratus lumborum, and the inferior part of the diaphragm, and is connected to the sides of the bodies of the lumbar vertebræ. The inferior edge of the transversalis is in some degree confounded with that of the internal oblique, particularly at their origin from Poupart's ligament: it seldom, however, descends as low as that muscle, and it crosses the spermatic cord, or round ligament, just as either of these is about to enter the abdomen. Replace the oblique muscles, divide their tendons all along the side of the linea alba, and dissect them off the rectus towards the linea semilunaris: this anterior part of the sheath adheres so closely to the lineæ transversæ, that it is difficult to separate it from them.

Rectus, long and flat, broader above than below, *arises* by a flat tendon, which is sometimes double, from the upper and anterior part of the pubis, ascends parallel to its fellow, becomes broad and thin above the umbilicus, and is *inserted* into the anterior part of the thorax by three fasciculi, the internal one of which is fixed to the ensiform cartilage and costo-xiphoid ligament; the middle longer and thinner to the cartilage of the sixth rib; and the external still broader and thinner to the cartilage of the fifth rib. *Use*, to bend the chest towards the pelvis, or to raise the latter towards the chest, also to compress the abdomen. The rectus is covered superiorly by the great pectoral, in the middle by the tendon of the external, and the anterior layer of that of the internal oblique muscle, and inferiorly by the external oblique and the conjoined tendons of the internal oblique and transversalis, also by the pyramidalis. These muscles are much nearer to

each other below than above, they are each enclosed in a distinct sheath, which consists, anteriorly, of the tendon of the external oblique and the anterior lamina of the internal oblique, posteriorly of the posterior layer of the internal oblique, and the tendon of the transversalis. This sheath commences at the edge of the thorax, and terminates midway between the umbilicus and the pubis; below which, all the tendons pass anterior to this muscle. If this part of the rectus be divided the deficiency in the back of the sheath will be obvious, as it generally terminates abruptly by a lunated edge; in some cases however, it ends gradually: the epigastric vessels ascend within this sheath, on the posterior surface of the muscle. The sheath of the rectus serves to confine this muscle in its proper place, and to prevent it, when contracted, from injuring the abdominal viscera immediately behind it; it also strengthens the parietes of the abdomen, and prevents the more frequent occurrence of hernia; the deficiency in the back part of the sheath below, may permit the abdominal muscles to exert more direct influence on the urinary bladder when distended. The rectus is intersected by three or four irregular, or zigzag, tendinous lines; one of these is always to be found opposite the umbilicus, a second midway between this and the xiphoid cartilage, opposite to which a third is always placed; if a fourth exist, it will be found below the umbilicus; these intersection are not complete; they are generally deficient on the back part of the muscle; the anterior part of the sheath adheres intimately to each of them, some fleshy fibres pass over one line and are inserted into those above and below; by means of these lines the rectus is enabled to act in distinct or separate portions, so as to compress different parts of the abdomen in succesion: anterior to the origin of the rectus is the following small muscle:

Pyramidalis, is sometimes absent, it *arises* broad and fleshy from the pubis, ascends obliquely inwards, and is *inserted* narrow and tendinous into the linea alba, midway between the umbilicus and pubis. *Use*, it assists the rectus, and makes tense the linea alba; it is covered by the tendon of the external oblique, by the triangular ligament and the conjoined tendons.

Dissect off the transversalis muscle in a direction from the ilium towards the linea semilunaris, and the *fascia transversalis* will be exposed covering the peritonæum; this fascia is connected to the internal lip of the ilium and to the whole length of Poupart's ligament, as far as the third insertion, from which it is continued behind the rectus to that of the opposite side; from these attachments, the fascia transversalis ascends between the peritonæum and the transversalis muscle, as high as the diaphragm and as far back as the psoas magnus; it is very strong and tense inferiorly for about an inch above Poupart's ligament, but superiorly it is little more than condensed cellular membrane: this fascia serves to support the peritonæum, particularly at the inferior part of the abdomen where the internal oblique and transversalis muscles are deficient; the spermatic cord or the round ligament always perforates this fascia about three quarters of an inch above Poupart's ligament, and about an inch and a half from the pubis; this perforation is called the *internal abdominal ring*, and is situated about midway between the spine of the ilium and the symphisis pubis; it is not a distinct opening, for the edges are prolonged along the cord, and lost in its cellular covering. The interval between the internal and external abdominal rings is traversed by the spermatic cord, and is named the *inguinal* or *spermatic canal*, to the

anatomy of which the student should particularly attend, as the disease of *inguinal hernia* is situated here, in the treatment of which a correct knowledge of this region will be required. The *spermatic* or *inguinal canal* commences at the internal ring, and leads obliquely downwards, forwards, and inwards to the external ring, where it terminates; this passage is bounded anteriorly by the tendon of the external oblique and by the inferior fleshy margin of the internal oblique and transverse muscles, posteriorly by the transversalis fascia and by the conjoined tendons of the two last named muscles, inferiorly by Poupart's ligament and its third insertion, superiorly this space is closed by the apposition of its opposite sides; in the male the spermatic cord and cremaster muscle, and in the female the round ligament of the womb passes through this canal, the obliquity or valve-like structure of which serves to protect the abdomen against a protrusion of it contents. Inguinal hernia occurs more frequently in the male than in the female sex, in consequence of the spermatic cord and the inguinal rings in man being larger than the ligamentum teres or these openings in the female: there are two species of this disease, oblique and direct. Oblique inguinal hernia is the more common form; in this case, the peritonæum or the hernial sac with its contents, protrude through the internal ring along the anterior part of the spermatic vessels to which it is connected by the surrounding cellular tissue and by the prolongation of the fascia transversalis from the edges of the opening; this covering of the hernial sac is called the *fascia propria* of inguinal hernia. When the tumor has arrived at the lower edge of the transversalis and internal oblique it insinuates itself between the cremaster muscle and the vessels of the cord, along which it descends to the external ring, where it is in general delayed for some time; the form of this opening and the inter-columnar fascia preventing its free passage through it; as the sac however descends towards the scrotum these inter-columnar fibres become closely united to the cremaster, and are gradually elongated on the surface of the tumor. If the sac of an oblique inguinal hernia which has passed the external ring be carefully dissected, it will be found covered by the following parts; beneath the integuments the superficial fascia, in general much thickened and divisible into several laminæ, will be seen to surround the tumor; on dissecting off this, the fibres of the cremaster, in general also thickened, will be observed spread on the forepart and sides of the sac, the inter-columnar bands from the external oblique tendon will be found closely connected to this muscle, and both will form a sort of capsule for the sac, suspending it towards the abdomen; if this covering be divided, the fascia propria will appear closely investing the tumor, and so adhering to it as to be separated with difficulty from it; this covering can often be divided into several layers, it presents, however, great difference in different cases; beneath this, the hernial sac, or the peritonæum will be found, which also in cases of old hernia will be considerably thickened; on opening the hernial sac, its contents, either omentum or intestine will be seen. The student should next attend to the situation of the epigastric vessels and their relation to the parts concerned in oblique inguinal hernia; these vessels are placed behind the fascia transversalis between it and the peritonæum, and in general can be discerned through the fascia; if not, a little dissection will render them apparent; two veins usually accompany the artery, one on either side; sometimes there is but one

epigastric vein, and that is on the pubal or inner side of the artery; the *epigastric artery* arises from the external iliac near Poupart's ligament; it first descends a little forwards and inwards, then ascends towards the rectus muscle, immediately behind the fascia transversalis, and very near to the inner or pubal side of the internal abdominal ring; in oblique inguinal hernia the neck of the sac is nearly in contact with the epigastric vessels, which thus bound it on its internal side, hence the rule of practice, in performing the operation for the relief of strangulated inguinal hernia, when the stricture is seated in the neck of the sac, is, to direct the edge of the knife or bistoury upwards and outwards. *Direct* or *ventro-inguinal hernia* protrudes directly through the external ring without descending along the spermatic channel: the occurrence of this disease is in a great degree guarded against by the fascia transversalis, and by the conjoined tendons which lie immediately behind the external ring; the edge of the rectus, the triangular ligament and the spermatic cord may be also all enumerated as additional protections to this part of the abdomen: in this species of hernia the sac will be found covered only by the integuments, superficial fascia and some tendinous and aponeurotic bands it may have carried before it; it is not covered by the cremaster, and in general it descends along the inner side of the cord, but in some cases it passes behind it; it is never, however, found between the cremaster muscle and the spermatic vessels. The epigastric vessels lie to the iliac or outer side of the neck of the sac; in dividing the latter therefore, in case this operation be required during life, the edge of the knife should be directed upwards and inwards. When the disease of inguinal hernia has continued for a considerable length of time, the spermatic canal will be found altered in many respects from its natural condition; it will have become dilated and shortened, and the abdominal rings expanded and approximated so as to render it difficult to distinguish the oblique from the direct inguinal hernia.

In connection with inguinal hernia, the student may next study the anatomy of the groin in reference to *crural hernia*, or he may postpone this dissection until the contents of the abdomen have been examined and removed; we shall however here subjoin the description of the parts concerned in this disease: remove the integuments from the anterior part of the upper third of the thigh, the superficial fascia will be seen descending over Poupart's ligament to invest the lower extremity; in the groin this fascia is very thick, and may be divided into several layers, which are separated by lymphatic glands and the superficial inguinal vessels; this fascia may be easily raised from the fascia lata on the outer and inner sides of the thigh, but in the middle of the groin and about an inch below Poupart's ligament, these fasciæ are almost inseparably joined; when the superficial fascia shall have been dissected off the forepart of the thigh, we shall see several lymphatic glands, the saphena vein and some small blood-vessels lying on the fascia; in structure the latter more resembles the superficial, than the fascia lata; the form and boundaries of the *inguinal region* also may then be more distinctly seen; this space is triangular, the base is Poupart's ligament; the apex is inferiorly, formed by the meeting of the Sartorius and adductor muscles; the external side is very prominent, and consists of the sartorius, iliacus, rectus and other muscles, all covered by the fascia lata; the internal or pubic side is flat and on a plane posterior to the

iliac; it is formed by the pectinæus and adductor muscles, also covered by the fascia lata. The inguinal lymphatic glands are irregular in number and size; they are in general about twelve in number, and may be divided into a superficial and a deep set; the former are the more numerous, and may be arranged from their situation into the superior and inferior; the superior are small, four or five in number, lie parallel to Poupart's ligament, some above, others below it; the inferior are two or three in number, larger than the former, and placed perpendicularly or parallel to the saphena vein; in general one lies behind this vessel; the deep inguinal glands are beneath the fascia lata, are three or four in number, and are closely connected to the sheath of the femoral vessels, chiefly to its inner side; in general one occupies the femoral ring. The Saphena vein is the principal cutaneous vein of the lower extremity; it will be seen in a future dissection to arise from the dorsum and inner side of the foot, and to ascend in front of the inner ankle along the inner side of the leg, and passing behind the inner condyle of the femur it continues to ascend along the inner and anterior part of the thigh to within about two inches of Poupart's ligament, when it passes through an opening in the fascia lata (the saphenic opening) and joins the femoral vein. The saphenic opening in the fascia lata will be very distinctly seen if the vein be divided on the thigh and raised towards Poupart's ligament, it presents a well marked semilunar edge, the concavity looking upwards; the edge, though apparently sharp, yet if carefully examined will be found reflected backwards on the sheath of the femoral vessels; remove the inguinal glands, clean the surface of the fascia lata, to the connections of which in this region the student should next attend. The fascia lata may be observed to be united to the spine of the ilium, to the whole length of Poupart's ligament, also to the linea innominata and spine of the pubis; it covers the muscles on either side of the groin, and the vessels in the middle: for the purpose of more particular examination, this fascia may be divided into three portions, the internal or pubic or pectineal portion, the external or iliac, and the middle or cribriform; the *internal* or *pubic portion* covers the pectinæus, gracilis, and adductor muscles, and is inserted internally into the ramus of the ischium and pubis; superiorly into the linea innominata or ileo-pectinea, anterior to Gimbernaut's ligament; externally it passes behind the sheath of the femoral vessels, and at the edge of the psoas tendon divides into two laminæ, one passes beneath that tendon, and is attached to the capsular ligament of the hip joint; the other passes over that tendon and is continued into the deep surface of the fascia iliaca. The middle portion of the fascia lata is very thin, and has been termed the *cribriform fascia;* this extends from the saphena vein to Poupart's ligament, and is connected on either side to the pubic and iliac portions of the fascia lata. The cribriform fascia covers the femoral vessels, and is perforated by the lymphatic vessels passing to the iliac glands; this portion of the fascia lata is more closely connected than any other to the superficial fascia: indeed in structure it resembles the superficial more than the fascia lata, nor are its fibres directly continued from those of the fascia lata; some have therefore considered the cribriform fascia as a deep lamina of the superficial fascia; in many cases, however, it has an aponeurotic structure and appears to be clearly derived from the iliac portion, and inserted into the pubic portion of the fascia lata; it presents much variety in this respect. The *external* or *iliac portioa*

of the fascia lata is very dense and strong, it is continued from the external surface of the thigh, and is intimately attached superiorly to the spine of the ilium, and to Poupart's ligament; and uniting with the cribriform fascia, is continued in front of the femoral vessels, along with the inferior fibres of Poupart's ligament, and is inserted along with these into the linea innominata, thus assisting to form the external part or the base of Gimbernaut's ligament. If the cribriform fascia be removed along with the superficial fascia, then the iliac portion of the fascia lata will present the appearance of a crescentic or falciform process, extending across the femoral vessels, the concavity of which process will look downwards and inwards: the inferior cornu joins the external cornu of the saphenic opening, and the superior cornu is inserted along with the posterior fibres of Poupart's ligament or Gimbernaut's ligament into the linea innominata, on the internal border of the crural ring: although this crescentic process appears to present a defined edge, yet if the latter be examined closely it will be found reflected backwards on the sheath of the vessels and on the muscles, in the same manner as the apparent edge at the lower part of the saphenic opening.

Next direct your attention to the internal surface of the crural arch, and to the connection between it and the deep fasciæ of the abdomen; divide the fascia transversalis from the spine of the ilium towards the rectus muscle; dissect it carefully down from the peritonæum, then push up this membrane, together with the cæcum or sigmoid flexure of the colon, out of the iliac fossa, to which they are connected by very loose cellular membrane; we thus obtain a view of the internal surface of Poupart's ligament, and of the parts which pass beneath it, and which naturally fill the space or cavity of the crural arch: first observe the fascia transversalis attached to the inner lip of the ilium and to Poupart's ligament from the spine of that bone, as far as the pubis, into the linea innominata of which it is inserted; here also it is inseparably joined to the conjoined tendons of the internal oblique and transverse muscles: as this fascia is passing anterior to the iliac or femoral vessels, a portion of it extends beneath Poupart's ligament, in front of these vessels, so as to form the *anterior* part of their sheath; this process of the fascia transversalis soon becomes thin and indistinct, and is lost in the cribriform part of the fascia lata. The *fascia iliaca* is a tolerably strong aponeurosis; it covers the iliac and psoas muscles, passes behind the iliac vessels, and adheres to the upper margin of the pelvis; externally it is connected to the inner edge of the ilium, and inferiorly it is attached to Poupart's ligament, and to the fascia transversalis, from the spine of the ilium as far inwards as the iliac artery; here it presents a semilunar edge, separates from Poupart's ligament, and from the fascia transversalis, passes behind the femoral vessels, forms the *posterior* part of the sheath, adheres to the pubis, and to the capsule of the hip joint, and is connected to the pubic or pectinæal portion of the fascia lata. The fascia transversalis and iliaca may be compared to a funnel, containing in the superior wide portion the peritonæum and its contents, and enclosing in the inferior narrow part, or pipe, the femoral vessels, and one or two lymphatic glands; of this funnel the fascia transversalis forms the anterior, and the fascia iliaca the posterior wall; these fasciæ may be now seen to be perfectly continuous with each other, between the vessels and the spine of the ilium; different names only being applied to different portions of one extensive aponeurosis;

as the iliac and transverse fasciæ are continued one into the other, external to the iliac artery, a white line may be observed; this is the circumflex ilii artery enclosed in a sort of canal between these fasciæ and Poupart's ligament, to which these aponeuroses are united.

The student should next consider how the space, commonly called the crural arch, is naturally filled; that portion of it between the spine of the ilium and the iliac or femoral artery is occupied by the psoas and iliac muscles; imbedded between these muscles is the anterior crural nerve; on the pubic side of these muscles is the femoral artery, next to which is the femoral vein, and at a little distance to the pubal side of this vessel is Gimbernaut's ligament, which closes the internal part of this space; thus, almost all the crural arch is filled, except a small portion between the femoral vein and the third insertion of Poupart's ligament; this space is the *femoral* or *crural ring;* this is somewhat of a triangular form, the base, externally, is the femoral vein, the apex internally is Gimbernaut's ligament; it is bounded anteriorly by Poupart's ligament, and by the superior fibres of the falciform process of the fascia lata, and posteriorly by the pubis, covered by the pectinæal muscle, and by the pectinæal portion of the fascia lata. Gimbernaut's ligament prevents femoral hernia occurring internal to this space, which is the only part in the crural arch where a hernia can descend, and even here this accident is in a great degree guarded against, as a lymphatic gland generally occupies this situation, and a layer of condensed cellular membrane extends across the opening; this layer is named the *fascia propria;* this fascia, though weak and indistinct in the natural and healthy state, becomes very thick and strong in cases of old femoral hernia; the fascia propria may be described as arising thin and delicate from the fascia iliaca on the external side of the iliac vessels; passing over these vessels it descends internally into the pelvis; inferiorly it is continued along these vessels to Poupart's ligament, covers the femoral ring, and then ascending is lost on the inner surface of the fascia transversalis. Crural hernia cannot occur external to the ring, as there the femoral vessels fill up the space, and strong partitions pass from the fascia transversalis to the fascia iliaca on the inner side of the vein, and between it and the artery; these prevent the distension of the sheath; the fascia propria also rounds off the angle between the fascia transversalis and the forepart of the vessels, and prevents a hernia occurring in front of the artery or vein; external to these vessels the crural arch is completely closed by the close connection between the fasciæ transversalis and iliaca to Poupart's ligament, in front of the psoas and iliac muscles. *Femoral hernia* then can occur only at the femoral or crural ring; this disease is more frequent in the female than in the male, the crural arch and ring being larger in the former than in the latter; femoral hernia descends through a sort of canal which commences at the crural ring, and ends at the saphenic opening in the fascia lata, through which the sac protrudes; the hernial sac in descending carries before it the fascia propria, descends in the sheath of the vessels along the inner side of the vein, and may remain in this situation for a considerable time; as the tumor increases in size it bursts through the sheath, and either tears or dilates some opening in the cribriform fascia, and then turns forwards into the groin; if the tumor increase still further, it is found to turn upwards over Poupart's ligament, and to rest on the lower part of the tendon of the external oblique;

the form of the crural ring, the course of the superficial epigastric vessels, and the close connection between the superficial and cribriform fasciæ, account for its ascending in this manner. If we dissect off the integuments from a femoral hernia of long standing, we shall find beneath them the superficial fascia so increased in thickness and vascularity as to present a compact and almost fleshy-like appearance; when this shall have been divided, the tumor can be brought down off the abdomen into the groin, and will be found covered by a dense and smooth capsule, which often presents a glossy appearance; this is the fascia propria; in dissecting off this, it will in general be found to consist of several laminæ, which sometimes separate so easily and appear so distinct as to lead an inexperienced operator to suppose that the hernial sac itself is exposed. These then are the coverings of the sac, which is thus placed external or superficial to the fascia lata: the neck of the sac, however, it is to be recollected, lies deep within the sheath of the vessels, and is therefore covered by the fascia transversalis, and by the superior cornu of the falciform process of the fascia lata. Let the student now review the dissection that has been made; let him move the thigh in different directions, and he will remark that, when it is rotated inwards, Poupart's and Gimbernaut's ligaments, as well as the fascia lata, feel relaxed, and that the crural ring will feel larger or more dilatable; let him also observe the relation of the femoral vein, the epigastric vessels, and the spermatic cord or round ligament to this opening; pass up the finger from the groin into the crural ring, and suppose that the stricture on femoral hernia was seated here, and that this opening required to be dilated, he will now perceive that this may be done with most safety by directing the edge of the bistoury forwards and a little inwards, so as to divide the external edge of Gimbernaut's ligament, which edge is composed of the insertion of the superior cornu of the falciform process of the fascia lata; the stricture on femoral hernia may, however, be seated lower down than in the neck of the sac; it may be situated in that opening of the cribriform fascia through which the hernial sac has protruded; in such a case, the stricture may be divided by directing the edge of the knife directly inwards along the surface of the Pectinæus muscle.

§ 2.—*Dissection of the Viscera of the Abdomen.*

The abdomen is the largest cavity in the body; it is of an oval form; its capacity, and in some degree its figure, differ at different ages and in different subjects; it is bounded superiorly by the diaphragm, anteriorly and laterally by the abdominal muscles, inferiorly by the true and false pelvis, and posteriorly by the lumbar vertebræ, the crura of the diaphragm, and the psoæ and quadrati lumborum muscles. Although the expression "cavity of the abdomen" is in common use, it is not correct, for during life there is no cavity, as the diaphragm and abdominal muscles by their alternate action keep up such a constant and uniform pressure on the viscera, that these and the parietes are always in perfect contact. The abdomen contains the peritonæum and the organs of digestion; the kidneys, renal capsules and ureters; also the thoracic duct, the aorta, vena cava, and the numerous branches of these vessels. The abdomen is very generally divided by anatomical writers into nine, and by some into twelve different regions; by drawing two transverse

lines, one between the extremities of the cartilages of the 9th rib, and the other between the anterior superior spinous processes of the ossa ilii, we may define three regions; the epigastric above, the umbilical in the middle, and the hypogastric below; and then by drawing a vertical line on each side from the extremity of the ninth rib to the anterior superior spinous process of the ilium, we shall subdivide each of these regions into three parts: the three divisions of the epigastric region are the epigastrium, or scrobiculus cordis in the centre, and the *right* and *left* hypochondriac regions on either side; the epigastrium is immediately below the ensiform cartilage, and the hypochondriac regions are covered by the false ribs; the lateral portions of the umbilical division are the lumbar regions; the middle of the hypogastric region is the hypogastrium, and the lateral portions are the iliac regions; the lower part of the hypogastrium is called by some the pubic region, and the lower part of each iliac division is called inguinal region, and contains the iliac vessels, and in the male the spermatic cord, and in the female the round ligament of the uterus. The viscera, which constantly or occasionally occupy the other regions of the abdomen will be seen when the peritonæal cavity has been opened, and with these the student should make himself familiar, as this knowledge may be of practical importance in cases of wounds penetrating this cavity, or in making an examination during life to detect any suspected organic disease. Dissect the abdominal muscles off the peritonæum; these can be easily separated laterally and inferiorly; but anteriorly, particularly near the umbilicus, it will be found very difficult to detach the sheath of the rectus from this membrane; the external surface of the peritonæum, which is thus exposed, appears rough and cellular, from its connection to the superincumbent muscles; three ligamentous cords are seen extending along it anteriorly and inferiorly, from the summit and sides of the urinary bladder towards the umbilicus; the central one of these is the remains of the urachus, and that on each side is the obliterated umbilical or hypogastric artery; anteriorly and superiorly we perceive another ligamentous substance, ascending from the umbilicus obliquely backwards, and to the right side; this is the remains of the umbilical vein; it is at first placed between the peritonæum and the muscles, but it soon sinks deep towards the liver, carrying around it a fold of peritonæum, named the suspensory ligament of the liver, which will be seen when the peritonæum is opened; the epigastric vessels also may be observed ascending from each inguinal region, and branches of the internal mammary arteries descending on the surface of this membrane. Next open the peritonæum by an incision from the ensiform cartilage to the umbilicus, and from this point carry another on each side obliquely downwards, to the spine of the ilium: on throwing down the inferior flap thus formed, we remark on its internal surface the projections of the three ligamentous cords which were before noticed as ascending from the bladder to the umbilicus; we may also remark how the external of these cords, or the obliterated umbilical artery on each side, throws the lower part of the peritonæum into pouches, two on each side, the *external and internal inguinal pouches;* the former lies between the ilium and the obliterated hypogastric vessel, the latter between this cord and the fundus of the bladder. The external pouch is large and very concave internally, and appears to protrude towards the inguinal canal: the existence of this pouch may conduce to the production of oblique inguinal as well as of femoral hernia; the internal pouch lies behind the external ring,

and becomes protruded in direct or ventro-inguinal hernia. When the peritonæum has been fully opened, we perceive its inner surface smooth and polished like all serous membranes, and filling its cavity we see the numerous digestive organs; these, though apparently within this bag, are really behind it, and only protrude the posterior side of this large sac into the cavity; nothing is contained within the peritonæum but the serous fluid, which is constantly exhaled, for the purpose of lubricating its opposite sides. We also obtain a partial view of the following organs, which in general occupy the same situation during life as we perceive them now to hold. Filling the right hypochondrium is the liver, with the fundus of the gall bladder projecting a little below it. In the epigastric region we see a portion of the liver also, resting on the stomach, and below it we see the pylorus and the commencement of the duodenum; in the left hypochondrium lie the spleen and great extremity of the stomach; in the right and left lumbar regions we find the colon, ascending through the former, and descending through the latter, behind which is each kidney; the duodenum also partly occupies the right lumbar region; through the proper umbilical region the transverse colon runs, not fixed however in any particular part of it, and from this intestine we perceive the great omentum descending towards the lower part of the abdomen, presenting however, very different appearances in different subjects; in some being expanded over the small intestines, so as nearly to conceal them; in others being coiled up into a narrow fold, and often concealed in some recess between the surrounding viscera: the convolutions of the jujunum and ilium intestines occupy the lower part of the umbilical, and extend indifferently into the hypogastric, and iliac regions; the cæcum or caput coli is fixed in the right, and the sigmoid flexure of the colon in the left iliac fossa; the rectum and other pelvic viscera occupy the hypogastric regions, but will of course change their own situation as well as that of the small intestines, according as they are contracted or distended. The student may next examine the anatomy of the *peritonæum*; this is the largest serous sac or membrane in the body; it lines the abdominal muscles, and covers almost all the abdominal viscera; that portion which adheres to the parietes is called the *parietal*, and that covering the viscera the *visceral layer*.

The peritonæum is a shut sac, and therefore when opened presents one continued surface, which may be traced throughout the whole extent without any interruption; it covers the viscera in such a manner as that they lie external or posterior to it; the familiar example of the double night-cap on the head has been, not unaptly, adduced, to explain how the viscera may be covered by the peritonæum, and yet really lie beneath it or behind it. Let us now trace this membrane through its entire extent, commencing at the umbilicus; from the transverse incision that was made into it in this situation, we may perceive it to ascend on the internal surface of the transverse and recti muscles, as high as the margin of the thorax; then bending back, it adheres to the inferior surface of the diaphragm, and continues very far back on this muscle, particularly in the left hypochondrium; from the diaphragm it is reflected on the spleen on the left side, on the stomach in the centre, and on the liver on the right side; it is also reflected on this last named viscus by a distinct fold, the falciform or suspensory ligament, from the umbilicus, and from the abdominal muscles on the right side of the linea alba: as the peritonæum is reflected from the diaphragm on each side of these organs in the

epigastric and hypochondriac regions, it forms folds, which to a certain extent serve as ligaments; these will be noticed more particularly in the examination of the individual viscera. Having covered the organs in the upper division of the abdomen, it is continued downwards in the following manner: having invested both surfaces of the liver as far as its transverse fissure; it is connected along and around the vessels of this gland towards the lesser curvature of the stomach; this fold, which thus surrounds the hepatic vessels, is called the lesser or the gastro-hepatic omentum; it is also sometimes named the capsule of Glisson; at the lesser arch of the stomach the two laminæ of this process separate to enclose the stomach, the posterior layer giving a serous covering to the back part of this organ and in like manner the anterior layer covering its anterior surface, on which it is continuous with that portion of peritonæum which has descended from the diaphragm, and with that which is also continued from the spleen to the stomach. The peritonæum having thus enclosed the stomach and its vessels between the two layers of the lessor omentum, we next observe that these laminæ having passed the great curvature of the stomach touch each other, and being joined by the peritonæum from the lower end of the spleen, descends under the name of the gastro-colic or the great omentum, to the lower part of the abdomen: in general it descends lower on the left side than on the right; it then turns on itself, and ascends obliquely backwards to the arch of the colon, along the convex edge of which its laminæ separate to enclose this intestine and its vessels; along the concave edge of the colon these laminæ again unite, and increasing in density form that process which is called the transverse meso-colon, which passes backwards to the spine: opposite the duodenum this process separates into an ascending and descending layer: the inferior division of the duodenum lies between these; the ascending layer proceeds in front of the lower and middle divisions of the duodenum, up to the back part of the right lobe of the liver, where it becomes continuous with the peritonæal tunic of that viscus and with the posterior layer of the lessor omentum which is descending along the back part of the hepatic vessels. The descending layer of the transverse meso-colon expands into each lumbar region, in which it attaches the lumbar portions of the colon by a duplicature called the right and left lumbar meso-colon; in the centre the inferior layer of the transverse meso-colon adheres to the vertebral column, and to the great vessels which lie upon it, and is thence reflected forwards and downwards over the small intestines and their vessels, and returns around these to the spine, thus forming a very important and remarkably folded or plaited process named the mesentery. From the inferior surface of the mesentery the peritonæum extends into either iliac region, and descends into the pelvis in the middle; it serves to connect the cæcum in the right, and the sigmoid curve of the colon in the left iliac fossa; in the pelvis the peritonæum descends around the rectum, forming the process named the meso-rectum; opposite the lower third of the sacrum, it is reflected to the lower and back part of the bladder, and in the female to the upper and back part of the vagina, from which it ascends on the uterus, and forms on each side of this organ the broad ligament which supports the Fallopian tube and the ovary: the peritonæum is then reflected from the fore-part of the uterus to the back of the bladder, ascends, both in the male and female, along the posterior surface and sides of this viscus to its superior fundus, from which

and from the iliac fossæ, it is continued to the abdominal mucles; forms the inguinal pouches, and may then be traced on the inner surface of the recti and transverse muscles up to the umbilicus, where the sac was opened. The different folds which the peritonæum forms in this course are termed processes, the principal of which, in addition to the ligaments of the several organs, which shall be noticed in the description of the latter, are, the lesser omentum, the great omentum, the splenic omentum, the colic omentum, the appendices epiploicæ, the transverse, and the right and left lumbar meso-colons, the mesentery, meso-cæcum, and meso-rectum.

The *lesser* or *gastro-hepatic omentum* consists of two laminæ, which extend from the transverse fissure of the liver to the lesser curvature of the stomach and to the upper part of the duodenum: it contains between its layers the vessels of the liver, viz. the hepatic artery to the left side, the ductus choledochus to the right, and the vena porta behind and between both; at its connection to the stomach, it encloses the coronary vessels of this organ; the lesser omentum lies anterior to the foramen of Winslow, this omentum seldom contains much fat.

The *great* or *gastro-colic omentum* also consists of two laminæ, which descend from the lower end of the spleen, and from the anterior and posterior surface of the stomach; between these laminæ are several long and tortuous vessels, descending from the vessels of the stomach, and some adipose substance the quantity of which varies very much in different subjects; the great omentum descends in front of the large and small intestines to the lower part of the abdomen, in general lower on the left than on the right side; (this explains the reason why omentum is more frequently found in a herniary sac on the left than on the right side;) it then turns upwards and backwards until it reaches the transverse arch of the colon; that portion of omentum, therefore, which is inferior to the colon, consists of four laminæ, two descending and two ascending; these, in the young subject, can be separated from each other, and a distinct cavity can be seen between them; this is part of the cavity or bag of the omentum which communicates with the general cavity of the peritonæum by the opening of Winslow, and which will be more particularly described presently; at the arch of the colon the two ascending laminæ of the great omentum separate to enclose this intestine, and again uniting form the commencement of the following process.

The *transverse meso-colon* extends from the concave border of the arch of the colon backwards to the spine; this process is very strong and dense, it encloses the vessels of the colon and forms a sort of division or partition in the abdomen between the epigastric and umbilical regions; when the transverse meso-colon has arrived at the spine, its two laminæ separate, one descends, the other ascends; the descending layer is very strong, expands laterally into the right and left lumbar regions, in each of which it is reflected either partially or perfectly around the ascending and descending colon, and thus forms a short fold or process very irregular in different subjects, termed the *right* and *left lumbar meso-colons;* the inferior or descending layer of the transverse meso-colon is continued obliquely downwards in the middle line to form the mesentery, a process which we shall trace when we have pursued the superior or ascending layer of the meso-colon to its termination. This lamina is thin and delicate; it ascends in front of the inferior and middle portions of

the duodenum, and of the pancreas; it also covers the aorta and vena cava, and continues along this latter vessel to the liver, on the spigelian lobe of which it expands, and on it and on the right lobe, behind the foramen of Winslow, it becomes continuous with the peritonæum, which has been reflected on the back part of the liver from the diaphragm. As this ascending layer proceeds in front of the pancreas, it is continuous on each side with the posterior layer of the lesser omentum which covers the back part of the stomach. This ascending layer may be best seen and traced by dividing the great omentum a little below the stomach, and raising this organ towards the thorax: we shall thus lay open the cavity of the omentum, and shall be able to trace the parietes of this bag through their whole extent.

The *cavity of the omentum* extends from the transverse fissure of the liver superiorly, to the lower border of the great omentum inferiorly; it is bounded anteriorly by the lesser omentum, the stomach, and the anterior or descending portion of the great omentum; inferiorly it is formed by the great omentum turning on itself; and posteriorly it is bounded by the ascending portion of the great omentum, by the colon, by the transverse meso-colon, and by the superior or ascending layer of this process, which terminates at the liver. The cavity of the omentum communicates with the general peritonæal cavity through the foramen of Winslow; this opening is situated in the lower part of the right hypochondriac region just above the right lumbar; it is somewhat oval, bounded anteriorly by the lesser omentum and by the hepatic vessels, posteriorly by the termination of the ascending layer of the meso-colon which invests the vena cava, superiorly by the lobulus caudatus of the liver, and inferiorly by the superior portion of the duodenum; if the membrane composing the omenta be perfect, and if air be forced through this opening, it will descend behind the stomach, and will inflate the omental cavity; the great omentum, however, in general is so cribriform that this experiment cannot be performed; the principal use of this cavity is most probably to afford a serous surface or cavity for the stomach to move or to distend into posteriorly during the process of digestion.

The *splenic omentum* extends from the fissure in the spleen to the great end of the stomach, and is continuous inferiorly with the great omentum; the splenic vessels and the vasa brevia are contained between the laminæ of this process.

The *colic omentum* is a fold of peritonæum which descends from the upper part of the right or ascending colon; it generally lies posterior to the great omentum; it is composed of two laminæ, between which are contained blood-vessels and adipose substance.

The *appendices epiploicæ* are attached all along the large intestine; but principally to the transverse arch of the colon; they are small prolongations of the peritonæum, filled with a soft fatty substance; they are never found attached to the small intestine; they vary very much in different subjects in number and size; their use is not ascertained.

The *mesentery* is the largest and most remarkably process of the peritonæum; it is continuous with the descending layer of the meso-colon, and extends from the left side of the second lumbar vertebra obliquely downwards to the right iliac fossa; this is the root of the mesentery; from this it expands very much, and is folded round the jejunum and ileum intestines, and then returns

again to the spine or to the inferior surface of the root; the laminæ of the mesentery can be easily separated; between them we find the mesenteric arteries, veins and nerves, also numerous absorbent vessels and glands; the mesentery serves to support the convolutions of the small intestines and the numerous vessels passing to and from these.

The *meso-cæcum* is a fold of peritonæum which attaches the cæcum to the right iliac fossa; this process, however, is frequently imperfect; the posterior portion of this intestine being sometimes deprived of a serous coat, and connected to the iliac muscle by cellular membrane.

The *meso-rectum* is a short fold of peritonæum which connects the superior portion of the rectum to the upper and anterior part of the sacrum; it encloses the hæmorrhoidal vessels and nerves.

The viscera of the abdomen are the digestive and urinary organs; the former we shall examine first; they may be divided into the membranous and glandular. The membranous viscera are the stomach and intestinal tube; the latter is divided into the small and large intestine; the small intestine is subdivided into the duodenum, jejunum, and ileum; the large intestine into the cæcum, colon, and rectum. The glandular viscera are the liver, spleen, and pancreas. We shall consider the membranous viscera first, and commence with the description of the *stomach*, which is the most important part of the digestive apparatus, the principal change in the food being accomplished in this organ.

The *stomach* is placed between the œsophagus and duodenum, and communicates with both; it is situated in the left hypochondriac and epigastric regions, and a small portion of it extends into the right hypochondrium: from the left side it passes across the epigastric region, obliquely downwards and forwards, and near its right or pyloric extremity it bends a little upwards and backwards. The stomach is connected to the diaphragm by the œsophagus and by the peritonæum; to the spleen by the splenic omentum; to the liver by the lesser omentum, and to the arch of the colon by the great omentum. If the stomach be moderately distended with air or fluid, its form and connections can be better understood; it will then appear somewhat of a conical figure, the base to the left side, the apex to the right, the intermediate part being somewhat curved; it will present two extremities, the left and right; two orifices, the cardiac and pyloric; two surfaces, an anterior or superior, a posterior or inferior; and two curvatures or edges, the lesser or concave, the greater or convex. The *left* or *splenic extremity* is very large, swells into the left hypochondrium beneath the ribs, so as nearly to conceal the spleen; the right or *pyloric extremity* is much smaller, is cylindrical and slightly convoluted like an intestine; it lies anterior and inferior to the left or splenic end, and extends to the fundus of the gall bladder or to the edge of the lobulus quadratus of the liver; it sometimes descends into the umbilical region. The *cardiac orifice* is the highest point of the stomach; it is situated between the left or great end and the lesser curvature, about three inches distant from the former; it is surrounded by vessels and nerves. The *pyloric orifice* is between the stomach and the duodenum; it lies to the right side of the spine; it is, in general, in contact with the liver and gall bladder, and anterior to the pancreas; it lies inferior, anterior, and to the right side of the cardiac orifice; it has a peculiar firm, hard feel. The *anterior surface* looks upwards and

forwards, and is in contact with the diaphragm, the ribs, and the left lobe of the liver. The *posterior surface* looks backwards and downwards, and rests on the meso-colon. The lesser, or *concave edge* of the stomach, looks backwards and upwards towards the spine and lobulus spigelii of the liver; this edge, near the pylorus, is convex, the great edge being concave opposite to this; the lesser omentum is attached to it, and the coronary vessels run along it. The *great* or *convex edge* looks forwards and downwards towards the colon; to it the great omentum and the epiploic vessels are attached; in the empty or contracted state of the stomach, these edges are thin and directed almost vertically, but when the stomach is distended, they become enlarged and round, and continuous with the surfaces. The stomach is composed of *three tunics*, a serous, a muscular, and a mucous; these are connected to each other by two laminæ of cellular membrane; the *serous* or *peritonæal coat* is derived, as was before explained, from the laminæ of the lesser omentum, separating at the lesser curvature, expanding over its surfaces, and uniting along the convex edge, to form the great omentum: the serous coat is loosely united to the edges, but almost inseparably so to the middle of each surface and to the pyloric extremity; a layer of very fine cellular tissue connects this to the following tunic, the *muscular;* this consists of fibres, which run in three different directions; the first or superficial are longitudinal; they are continued from the œsophagus, and are very strong along the curvatures, particularly on the lesser; the middle layer of fibres run circularly; they commence at the left extremity, or cul de sac, and are arranged in nearly parallel rings; they are very strong about the centre, where they often cause a constricted appearance around the stomach, as if dividing it into two portions; the circular fibres again increase in thickness as they approach the pylorus; these fibres do not form perfect circles; the extremities of each fasciculus turn obliquely to one side; the third set of fibres take a very irregular or oblique direction; they are most distinct on the great end, or cul de sac, and appear as a continuation of the circular fibres of the œsophagus. Beneath the muscular tunic is the second lamina of cellular tissue, which contains the minute divisions of the nerves and vessels of the stomach, and has been, by some, called the nervous coat of the stomach. The *internal,* or *mucous* or *villous* coat is very soft, and of a pale red or rose color, sometimes interspersed with such very vascular patches as might lead the inexperienced to mistake them for the effects of inflammation: in order to examine this tunic of the stomach, this organ should be removed from the subject, everted and washed. This membrane will be found covered with a viscid fluid, and thrown into numerous rugæ, and will appear very different from that lining the œsophagus; at the pylorus it forms a circular fold, which is thin and floating; external to this is a circular fasciculus of muscular fibres, which have a peculiar dense feel: this fold of mucous membrane narrows the opening into the duodenum, and when assisted by the surrounding muscular fibres, can perfectly intercept the passage from the stomach into the intestine; in the cellular tissue, external to this membrane, particularly along the curvatures, are many small mucous glands, which open on the mucous surface; these are the *glandulæ Brunnerii:* the mucous coat of the stomach secretes the fluid called the gastric juice, which is generally believed to have the remarkable properties of being powerfully solvent and anti-putrescent. In

the stomach the food undergoes the first important change in digestion, being here converted into a soft homogeneous pulpy mass, called chyme.

The *duodenum* is the next portion of the alimentary canal; this is the first and shortest division of the small intestines; it extends from the pylorus to the root of the mesentery, where the jejunum commences; it lies partly in the right hypochondriac, and partly in the right lumbar and in the umbilical regions; it takes a semicircular course around the head of the pancreas: this course may be divided into three parts: the 1st, or superior transverse; the 2d, or perpendicular; and the 3d, or inferior transverse. The *superior transverse portion* ascends from the pylorus obliquely backwards and to the right side, beneath the edge of the liver, so as to touch the gall bladder; here the intestine makes a sudden turn, the superior angle, and the *middle* or *perpendicular portion* of it commences; this descends in front of the right kidney, as low as the third lumbar vertebra, where it makes a second turn (the inferior angle) from which the *inferior transverse portion* extends obliquely upwards, and to the left side, and at the first lumbar vertebra ends in the jejunum. The duodenum differs from the remainder of the small intestine, in being fixed in its situation, and being only partially covered by the peritonæum, and being of much larger caliber, particularly near the inferior angle: its muscular coat is very strong, and the valvulæ conniventes very numerous. The superior transverse portion is more contracted than any other part of it; it is covered on both surfaces by peritonæum like the stomach, and is, therefore, more movable than the rest of the intestine. The perpendicular portion is concealed by the omentum, and by the colon, and is covered by the ascending layer of the meso-colon; this portion lies on the right kidney, and on the vena cava, and has no peritonæum posterior to it; it is therefore fixed, and is dilatable; the biliary and pancreatic ducts perforate the inner side of this division of the duodenum: these pass through its coats very obliquely, and open into the intestine, sometimes distinctly, and at other times conjointly, on a small papilla, opposite the inferior angle. The inferior transverse part of the duodenum passes across the aorta and the right renal vessels; like the middle portion, it is only partially covered by the peritonæum, being placed between the layers of the meso-colon; its lower border may be seen without dissection, projecting through the inferior layer of the meso-colon; the superior mesenteric vessels pass in front of the termination of this part of the duodenum, and appear to compress it against the aorto, so as to retard the passage of its contents into the jejunum. In the duodenum, the chyme is mixed with the biliary and pancreatic fluids, and a separation takes places between the chyle and the excrementitious part of the food.

The *jejunum* and *ileum intestines* are covered by the omentum: if we raise this process and the arch of the colon, and place them on the edge of the thorax, the convolutions of these intestines will be seen in the umbilical, hypogastric, and iliac regions; convex anteriorly, concave posteriorly, and attached to the mesentery; the jejunum commences in the left lumbar, and the ileum ends in the right iliac region. There is no exact division between these two intestines; the upper two-fifths are named the jejunum, and are placed higher in the abdomen than the ileum, which is the name given to the three remaining fifths. The jejunum is redder, feels thicker, and is larger than the ileum, which is pale and thin: these differences are striking, when we compare the

commencement of the jejunum with the terminating portion of the ileum; in the intermediate space, however they are gradually lost; the greater vascularity and number of valvulæ conniventes in the jejunum than in the ileum account for these differences in these portions of the alimentary tube.

The *large intestine* forms about one-fifth of the intestinal canal, and is subdivided into the cæcum, colon, and rectum; the large intestine differs from the small, not merely is size, but in having a peculiar cellular and sacculated appearance, particularly when distended: small processes also (the appendices epiploicæ) are attached along its whole course; three strong muscular bands running in a longitudinal direction, may also be observed chiefly in the cæcum and colon; these appear to pucker the large intestine, so as to give it the cellular structure before mentioned: the large intestines are paler than the small, and much thinner, having but few valvulæ conniventes.

The *cæcum,* or *caput coli,* is situated in the right iliac fossa, in which region it is fixed by the peritonæum, which in general covers it only anteriorly and laterally, the cellular membrane connecting it posteriorly to the iliac and psoas muscles; in some, however, the peritonæum covers the cæcum all round and connects it to the iliac fossa loosely by a process, named the meso-cæcum; the cæcum is covered anteriorly by the abdominal muscles, and sometimes by the convolutions of the ileum; it lies beneath the right kidney, and is continuous with the ileum and the colon: the cæcum is somewhat triangular, the apex below, the base above at the colon: on its external surface are three irregular protuberances, one anteriorly, and two posteriorly; from the lower and posterior part of the cæcum a small process, named *appendix vermiformis,* about the size of a goose quill, hangs into the pelvis; it is attached to and communicates with the cæcum just below the ileum: a sort of mesentery connects it in its situation; its use is not ascertained. The ileum joins the left or inner side of the cæcum at a very acute angle; it appears to perforate the cæcum, the peritonæum and external muscular fibres of the ileum being continued into the corresponding parietes of the cæcum, while the circular fibres and mucous coat of the ileum protrude into the cæcum, as may be seen by opening the latter in a perpendicular direction, on the opposite, that is, on the right side, and washing out its contents; we then perceive the opening of the ileum, narrow, like a transverse slit, looking obliquely downwards and outwards, towards the right ileum, and protected by two semilunar folds of mucous membrane, which enclose a few muscular fibres. The inferior fold, or *ilio-cæcal valve,* is the larger, is placed somewhat vertical, and secures the ileum against any matter re-entering it from the cæcum, the superior fold, or *ilio-colic valve* is smaller, and placed rather horizontal; it secures the ileum against reguritation from the colon; these semilunar folds are united to each other at their extremities, (*commissures*) and from each commissure a prominent fold is continued round on the inner side of the cæcum: these folds are called the fræna or *retinacula* of these valves, in consequence of which, and of the commissures, the distension of the cæcum closes the ilio-cæcal foramen; the cæcum is provided with the same longitudinal bands as the colon; it has no valvulæ conniventes. The *colon* extends from the cæcum to the rectum; it is divided into four portions, the right or ascending, the middle or transverse arch, the left or descending, and the sigmoid flexure; there is, however, no mark of distinction whatever between these different divisions,

The *ascending colon* extends from the cæcum to the inferior surface of the right lobe of the liver, which it marks with a superficial depression; this portion of the colon is concave anteriorly, and covered by the peritonæum and by the abdominal muscles; it lies on the right kidney: the duodenum is connected to it internally; the superior extremity is generally tinged with bile from being in contact with the gall bladder.

The *transverse arch of the colon* extends tortuously from the right hypochondrium, across the inferior part of the epigastric or the umbilical region into the left hypochondrium; it is covered by the abdominal muscles, and lies anterior to the small intestines: on the right side it is connected to the liver, in the middle to the stomach and to the great omentum; and its left extremity, which is superior and posterior to the right, is attached to the spleen by peritonæum; the appendices epiploicæ are very numerous on this part of the colon.

The *left* or *descending colon* extends from the spleen to the left iliac region; it is longer than the right colon; it is connected to the left kidney and psoas muscle by the peritonæum and cellular membrane.

The *sigmoid flexure* is connected so loosely in the iliac fossa, that a great portion of it often lies in the pelvis: this part of the colon is partially covered by the small intestines, and is connected to the psoas and iliac muscles, to the ureter and spermatic vessels.

The *rectum* extends from the sigmoid flexure of the colon to the anus; it commences opposite the left ilio-sacral articulation, and descends obliquely towards the middle line as far as the lower end of the sacrum; it then bends forwards towards the perinæum, and lastly turning downwards, it ends at the anus. The rectum is connected posteriorly to the sacrum and coccyx by the meso-rectum superiorly, and by vessels and nerves inferiorly: anteriorly the rectum is connected to the peritonæum above, and below, in the male subject, to the inferior fundus of the bladder, the vesiculæ seminales, and the prostrate gland; in the female to the uterus and vagina: along the sides of the rectum is a considerable quantity of cellular tissue, and several vessels, particularly tortuous veins; inferiorly the levatores ani muscles cover the sides of this intestine, and its lower extremity is surrounded by the orbicular and cutaneous sphincters. The rectum is separated from the bladder in the male, and from the uterus in the female by the cul de sac of the peritonæum, which may or may not contain some of the small intestines according to the state of the pelvic viscera; the rectum, therefore, is only partially covered by peritonæum; in the superior third this membrane covers the intestine all around, forming the meso-rectum behind it; in the middle third the peritonæum is only connected to the forepart, and somewhat to its sides; and its inferior third is wholly unattached to this membrane. The rectum is not sacculated like the colon; it is found in general much dilated about an inch above the anus.

In order to examine the structure of the intestinal canal, let the student remove the following portions of intestine, including each part between ligatures, having first distended them with air; a portion of duodenum, of jejunum near its commencement, of ileum near its termination, of the arch of the colon, and of the upper part of the rectum;—1st, the duodenum possesses three coats connected to each other by cellular membrane; the

peritonæal or serous, the muscular and the mucous ; the first has been already mentioned as giving but a partial covering to this intestine ; the muscular coat of the duodenum is formed of strong red fibres, which take a circular direction ; there are very few longitudinal fibres to be observed along it, except on the superior transverse portion : lay open a part of this intestine, and the internal mucous coat will be found like that of the stomach, thrown into soft folds which lie nearly parallel to each other in a circular direction ; these are named valvulæ conniventes. 2d, The jejunum and ilieum also possess three tunics and intermediate cellular tissue ; the serous or peritonæal coat almost perfectly surrounds it, except the small triangular space along the concave side where the vessels and nerves divide, and which space admits of the more easy distension of the intestine ; the muscular coat is not so strong as on the duodenum, but more evidently consists of two sets of fibres: the longitudinal are the most superficial, they are very pale and indistinct, except along the anterior or convex side of the intestine ; the circular fibres lie beneath these ; they are more distinct, but also very pale : no fibre passes perfectly round the tube. The mucous coat is paler than in the stomach, and is thrown into numerous folds, particularly in the jejunum ; these folds are smaller and less numerous in the ileum ; the muscular coat in the latter intestine also is paler and weaker than in the former. The folds of mucous membrane, called valvulæ conniventes, are larger in the jejunum than in the duodenum or ileum ; in the first they will be found to be a quarter of an inch deep in some situations ; in others, however, much less ; they form arches which encircle about three-fourths of the intestine, and end, some in a point, others are forked or pass off obliquely into adjacent folds : these valves are of use in delaying the food in its passage along the canal, thus affording to the absorbents a better opportunity to imbibe all the nutritious matter or the chyle it may contain ; in proportion also as the intestine becomes distended, these valves become more tense, and project into the canal, so as to separate the food into smaller portions, and thus expose the entire mass to the action of the absorbents : on each of these valves are a number of small conical projections called *villi:* when these are examined through a magnifying glass, small pores are observable ; these are the mouths of the lacteal or absorbent vessels. Very small mucous glands are attached to the external surface of the mucous membrane of the intestine throughout its whole length ; larger glands may be noticed in different situations, some scattered singly, others collected into clusters ; the former, or the glandulæ solitariæ, or Brunneri, are most distinct in the duodenum ; the latter, or the grandulæ aggregatæ or Peyeri, are most obvious in the ileum, particularly near its termination. 3d, The large intestine in some situations, as has been already observed, is but partially covered by peritonæum ; this membrane is more loosely connected to the transverse arch of the colon than it is to the small intestine, and is unattached along two triangular spaces, one along the concave border between the laminæ of the mesocolon, the other along the convex, between the layers of the great omentum ; this circumstance favors the distension of the colon. The muscular coat of the large intestine also consists of longitudinal and circular fibres ; the former, however, are collected into three fasciculi, all of which commence at the vermiform process, and pass along the cæcum and colon to the rectum : on this intestine the fibres separate, increase in thickness and number, and form

a more perfect tunic; near the anus these fibres are confounded with those of the levator ani muscle of each side. The internal or mucous coat of the large intestine is pale, and forms but few and imperfect folds; in the rectum it becomes more vascular and villous, and presents several longitudinal folds as also three or four very remarkable, in a horizontal direction. As the food is propelled along the intestinal canal, the chyle is absorbed by the numerous lacteal vessels to which it becomes exposed; it is also mixed with a quantity of fluid (*succus intestinalis*) secreted by the mucous glands, and by vessels of the mucous membrane; in the large intestine the food first presents the fæculent properties, and in its passage along this part of the canal, the absorbent vessels continue to take up any chyle that may have escaped the preceding, as well as to absorb the watery parts of the food.

The glandular viscera of the abdomen which are subservient to the process of digestion are the Liver, Spleen, and Pancreas.

The *Liver* is the largest secreting gland in the body; it fills the right hypochondrium, extends through the anterior part of the epigastric region into the left hypochondrium as far as the cardiac orifice of the stomach, beyond which however, it frequently extends, even to the spleen; it is situated below the diaphragm, and above the right kidney, the stomach, duodenum and lesser omentum; it is supported in this situation by several folds of peritonæum, termed ligaments of the liver, viz, the falciform, round, right, left and coronary; these connect it to the diaphragm and abdominal muscles, and the lesser omentum attaches it to the stomach and duodenum.

The *suspensory* or *falciform ligament* is a fold of peritonæum attached anteriorly by its convex border to the linea alba, to the rectus muscle of the right side, and to the diaphragm; it passes obliquely backwards and to the right side, and is attached by its posterior or concave edge to the upper or convex surface of the liver, on which its laminæ separate, and expand over each side of its organ; enclosed in the inferior edge of this fold is the obliterated umbilical vein, which substance in the adult is named the *ligamentum teris*: this, which is enumerated as the second ligament of the liver ascends from the umbilicus, obliquely backwards, and to the right side, and is inserted into a notch in the thin or anterior edge of the liver, which notch is the commencement of the umbilical or horizontal fissure of the liver. The *right* and *left lateral* ligaments are triangular folds, connecting the right and left lobes of the liver to the diaphragm: the left lateral ligament lies anterior to the cardiac orifice of the stomach; the right lateral ligament is directly above the right kidney. The *coronary ligament* is situated at the upper extremity of the falciform process, and consists of two laminæ of peritonæum, which separate from each other, and connect the superior thick edge of the liver to the diaphragm; between the laminæ of this process the liver is deprived of a serous covering and is in contact with the diaphragm; this space lies anterior to the inferior vena cava. The liver is of an irregular form; it is longer transversely than from before backwards; its posterior edge is very thick, and in contact with the diaphragm; its anterior edge is thin, convex, and on a level with the edge of the right hypochondrium, and with the lower part of the epigastric region; two notches may be observed in this edge; one below the falciform ligament into which the round ligament or obliterated umbilical vein enters; the other corresponds to the gall bladder.

The superior or anterior surface is smooth and convex, and divided by the suspensory ligament into a right and left portion, and is contiguous with the diaphragm. The inferior surface is very irregular, marked by several projections and depressions; the former are called *lobes*, and are five in number, viz. first, the *great* or *right lobe;* second, the *left*, separated from the former by the horizontal fissure; third, the *spigelian* or *middle lobe;* this is situated behind the lesser omentum and above and behind the transverse fissure, and between the œsophagus and the cava; it is connected to the right lobe by two roots; one is thin and placed vertically between the fissure for the vena cava and that for the ductus venosus; the other is thick and placed transversely, and is called *lobulus caudatus*, or the fourth lobe of the liver; the lobulus caudatus is immediately behind the transverse fissure, and extends from the spigelian, along the right lobe between the depressions marked by the colon and right kidney. Fifth, the *lobulus quadratus* or *anonymus*, is at the anterior part of the right lobe, in front of the transverse fissure, and between the gall bladder and horizontal fissure. The principal depressions or fissures on the inferior surface of the liver are the following: first, the *transverse fissure* which is situated between the lobulus quadratus and caudatus, and extends from the horizontal fissure transversely to the right; the vessels and nerves of the liver enter the gland in this fissure; second, the *horizontal fissure* extends from the notch in the anterior edge of the liver, backwards and upwards between the right and left lobes; the anterior part of this fissure contains the obliterated umbilical vein, the posterior part the obliterated ductus venosus; third, the *fissure for the vena cava* is between the lobulus spigelii and the right lobe; this, as the anterior part of the horizontal fissure, is frequently like a foramen in the liver, being surrounded by the substance of the gland; fifth, the *depression for the gall bladder* is on the inferior surface of the right lobe, and to the right side of the lobulus quadratus; the substance of the liver is sometimes deficient over this bag; sixth and seventh, *superficial depressions* on the under surface of the right lobe; the anterior corresponds to the *colon*, the posterior to the *right kidney* and its capsule; these depressions are indistinctly marked in some subjects; they are separated from each other by the extremity of the lobulus caudatus; eighth, a superficial depression on the under surface of the left lobe, corresponding to the anterior surface of the stomach; ninth, a broad notch in the posterior edge of the liver, corresponding to the spine and to the right crus of the diaphragm; the venæ cavæ hepaticæ leave the liver in this situation.

The liver is of a peculiar brown color, interspersed with yellow; in some subjects it is much darker than in others: in the very young it is red and soft, and in the old it is generally pale and yellow, and often hard and brittle; it has two coats, a serous and fibrous; the serous, or peritonæal tunic covers the whole surface of the liver, except in those situations where the vessels, either open or obliterated, are situated, and between the laminæ of the coronary ligament, also in the depression, in which the gall bladder is lodged. The 2d, or fibrous coat, is the immediate capsule to the gland; it is thin, little more than condensed cellular membrane; it is most distinct and strong where the serous coat is deficient; it covers the whole surface of the liver, and adheres to it by innumerable shreds or processes, which pass into its substance; it also accompanies those vessels of the liver which enter or leave the transverse

fissure, and forms a capsule or sheath around their ramifications throughout the entire organ; this sheath receives the name of the *capsule of Glisson;* it surrounds the vessels very loosely, and also encloses loose cellular tissue; hence it is, that if these vessels be divided by a perpendicular incision through the liver, they will be found to collapse and recede; whereas, if the venæ cavæ hepaticæ, which run from the thin towards the thick edge of the liver, be divided by a transverse incision through the liver, they will not recede or collapse, but remain perfectly open, in consequence of the absence of this sheath, and of their close adhesion to the substance of the liver. The structure of the liver consists of numerous small granulations of a brown and yellow color, connected together by the branches of the hepatic arteries, veins, and ducts; these grains are called *acini* of the liver, in each of them a branch of the hepatic artery and vena porta terminate, and out of each proceed a branch of the hepatic veins and ducts. Through the liver, therefore, *four* sets of vessels ramify, in addition to numerous lymphatics, viz. the branches of the hepatic arteries, venæ portarum, hepatic ducts and hepatic veins: the venæ portarum are supposed to be the vessels from which the bile is secreted; the hepatic arteries nourish the substance of the liver; the hepatic ducts carry the bile from this organ, and the venæ cavæ hepaticæ return the blood which has circulated through the liver, to the inferior venæ cavæ, just as this vessel is passing through the diaphragm. The *venæ cavæ hepaticæ,* three or four in number, are seen escaping from the liver at the superior thick edge, behind the coronary ligament, and immediately joining the inferior or ascending venæ cavæ. The three other vessels of the liver may be seen between the layers of the lesser omentum, the artery lying to the left side, the biliary duct to the right, the vena porta behind and between both; the artery and vein descend obliquely inwards towards the spine, behind the pancreas. The *hepatic artery* is a branch of the cæliac axis, and the vena porta commences in front of the last dorsal vertebra and behind the pancreas. The *right* and *left hepatic ducts,* on clearing the transverse fissure, unite and form the *hepatic duct,* which descends for about one inch and a half along the right side of the lesser omentum, is then joined by the cystic duct, from the gall bladder: the union of these forms the *ductus communis choledochus;* this vessel, about three inches long, descends vertically behind the pylorus, the upper part of the duodenum and the pancreas, and is imbedded in the substance of the latter, about the middle of the internal or concave side of the middle division of the duodenum, this duct perforates the coats of this intestine in a very oblique direction, and opens on a small papilla internally, opposite the lower angle of the duodenum: as the ductus choledochus is about to perforate the duodenum, it is in general joined by the duct from the pancreas.

The *gall bladder* is situated in the right hypochondrium in a depressing on the inferior surface of the right lobe of the liver: this membranous sac if of a pyriform figure; the large extremity of fundus being directed forwards and downwards; in some persons it projects below the liver against the abdominal muscles; it is generally contiguous to the pylorus and to the colon; the smaller extremity or neck of the gall bladder is directed upwards, backwards and inwards, is a little convoluted, and ends in the *cystic duct,* which is about an inch and a half long: this duct bends downwards and inwards, and joins the hepatic duct at an acute angle, the union of which forms,

as was before mentioned, the ductus choledochus. The gall bladder is closely united to the liver by the peritonæum, which passes over it; also by cellular membrane and small blood vessels; it is composed of a partial serous and a perfect cellular coat, and is lined by a mucous membrane; the latter has a peculiar honey-comb-like appearance, and in the duct is disposed in a spiral lamina. This viscus serves as a reservoir for the bile, when this fluid is not required in the intestinal canal. The bile is secreted in the liver, and flows down the hepatic duct, and if not required in the duodenum, or if obstructed in the ductus choledochus, it passes into the cystic duct to the gall bladder, where it resides a longer or shorter time, during which period its watery part is absorbed; at the end of some time, when the bile, is required to assist in digestion, it is forced out of the gall bladder, and then flows again along the same cystic duct to the ductus choledochus, and so to the duodenum. The bile is not secreted in the gall bladder, nor can it possibly enter or leave this viscus by any other channel than though the cystic duct.

The *Spleen* is situated in the left hypochondrium, between the stomach and the ribs, beneath the diaphragm, and above the kidney and the colon: it is connected to the diaphragm by the peritonæum, also to the stomach and pancreas by vessels and by the peritonæum. The spleen is somewhat oval; convex towards the ribs and concave towards the stomach; on the latter surface there are several holes, and about the centre of it a depression or fissure for the entrance and exit of blood-vessels; all this surface, however, is not concave, the part anterior to the vessels only being so, while the part posterior to them is convex; the color of the spleen is somewhat purple or livid; it is covered by peritonæum, and beneath this by a fibrous capsulæ, which invests its entire surface, and also passes into its substance along with the blood-vessels, and assists in forming the cells of which this organ is composed: these cells are found to contain a quantity of blood, partly coagulated; also a number of small grains, which may be separated by maceration, but the nature of which is not well understood; the spleen has no excretory duct. The exact use or function of this viscus is not yet ascertained; sometimes two or more small bodies, of the same color and structure as the spleen, are found in its vicinity, between the laminæ of the omentum.

The *Pancreas* lies behind the stomach, and may be exposed by dividing the great omentum below the stomach, and raising the latter organ towards the thorax. This conglomerate gland is of great length, about seven inches long, and about an inch and a half broad; it extends from the lower part of the left hypochondriac and epigastric regions, obliquely downwards and forwards into the umbilical region, where it is surrounded by the duodenum; it is covered by the stomach and the ascending layer of the meso-colon; it lies anterior to the left crus of the diaphragm, the vena porta, and aorta, and overlaps the concave border of the duodenum, to which it adheres very closely. The splenic or left extremity (its *tail*) is small, compared with the right, which is broad and flat, and is named the *head*; the anterior surface looks a little upwards, the inferior edge being raised forwards by the superior mesenteric artery and vein, which pass behind it; a groove may be remarked on the posterior and upper part of the pancreas; this contains the splenic artery and vein. The *pancreatic duct* may be seen by scraping off a little of the posterior surface of the gland about its centre. This duct is remarkably white and thin; it

commences in the small extremity of the gland, and extends to the large end, receiving in its course numerous branches on each side: it usually joins the ductus choledochus; it sometimes, however, opens into the duodenum distinctly; attached to the head of the pancreas there is sometimes a glandular mass of the same structure as the pancreas, and opening by a small vessel in the pancreatic duct; this is named the *lesser pancreas.* The pancreatic fluid is supposed to be of use in diluting the bile, and rendering it and the contents of the duodenum more miscible with each other. The structure of the pancreas is similar to that of the salivary glands, and is thence called by some, the abdominal salivary gland.

OF THE VESSELS AND NERVES OF THE ABDOMEN.

THE abdominal aorta gives off three large branches to supply the organs of digestion, viz. the cœliac axis, the superior mesenteric and inferior mesenteric arteries. The *cœliac axis* may be seen by tearing through the lesser omentum above the lesser curvature of the stomach, to arise from the forepart of the aorta, at the upper edge of the pancreas; it is about half an inch long, and divides into three branches, viz. the gastric, hepatic and splenic; the *gastric* artery and its branches run between the laminæ of the lesser omentum, along the concave edge of the stomach, and supply both surfaces of this organ. The *hepatic artery* accompanies the vena porta and the biliary duct to the transverse fissure of the liver, first sending off a small branch to the pylorus (pylorica superior,) next a large branch (gastro-duodenalis,) which descends behind the pylorus and subdivides into two branches, the pancreatico-duodenalis and gastro-epiploica dextra; the former supplies the pancreas and duodenum; the latter runs along the convex edge of the stomach, between the layers of the great omentum; the hepatic artery then divides into the right and left hepatic arteries which supply the right and left lobes of the liver; the right hepatic is the larger, and gives off a small branch, arteria cystica, to the gall bladder. The *splenic artery* is the longest and largest branch of the cœliac axis; it passes along the upper and posterior part of the pancreas, to which it gives many branches; near the spleen it sends off the gastro-epiploica sinistra, which runs along the convex edge of the stomach, between the layers of the great omentum; the splenic artery then divides into five or six branches, which enter the foramina in the concave surface of the spleen: from these splenic branches five or six small arteries, the vasa brevia, pass to the left or great end of the stomach. The *superior mesenteric artery* arises about half an inch below the cœliac axis, behind the pancreas; it descends in front of the duodenum, enters the mesentery, and bends obliquely towards the right iliac fossa; from its left or convex side it sends off sixteen or eighteen branches, which supply the jejunum and the ileum, and from its concave or right side arise three branches, the ileo-colica, colica dextra, and colica media; these arteries supply the corresponding portions of the colon. The *inferior mesenteric artery* arises a little above the division of the aorta into the iliac vessels: it descends to the left side, and divides into three branches. 1st, The colica sinistra, which supplies the left lumbar colon, and inosculates with the colica media; 2d, the sigmoid artery, which supplies the sigmoid flexure of the colon; and 3d, the superior hæmorrhoidal, which is distributed to the rectum.—These arteries

are accompanied by corresponding veins, which all unite to form the vena porta; the *inferior, mesenteric vein* accompanies the artery of that name to the aorta, and there joins the *superior mesenteric vein*, which is a very considerable vessel; this common trunk then ascends behind the pancreas, and is joined by a very large vein from the spleen; the confluence of the splenic and mesenteric veins forms the commencement of the *vena porta*: this vessel ascends obliquely to the right side, surrounded by nerves and cellular membrane, and enclosed in the lesser omentum; near the transverse fissure it becomes dilated (the sinus of the porta) and then divides into the right and left branches; the former is the larger, the latter the longer of the two; each branches out through the liver, surrounded by the capsule of Glisson, and runs in a transverse direction; injection shows their minute branches to communicate in the acini with the pori biliarii, or with the commencements of the hepatic ducts.

The nerves which supply the digestive organs are the 8th pair, and the splanchnic branches, from the sympathetic: the *8th pair* descend along the œsophagus, and are distributed almost wholly to the stomach; some few branches pass along the lesser omentum to the liver. The *splanchnic nerves* are two in number, a right and left; they are each formed by filaments from the dorsal ganglions of the sympathetic nerve in the thorax; they enter the abdomen either along with the aorta, or perforate the crura of the diaphragm on either side of that vessel; in the abdomen each nerve soon ends in a large ganglion, the *semilunar ganglion*, from which numerous branches pass across the aorta, around the cœliac axis, and communicating with each other, form the nervous plexus, named *solar* or *cæliac plexus*, from which a fasciculus of nerves extends along each of the branches of cœliac artery to supply the viscera in the epigastric region; thus a few accompany the gastric artery and communicate with the 8th pair on the stomach; several surround the hepatic artery, and by it are conducted to the liver; in like manner others also pass to the spleen. From the lower part of the solar plexus several large branches descend and become attached to the superior and inferior mesenteric arteries, form plexuses around these vessels, and receive additional branches from the lumbar or abdominal ganglions of the sympathetic; these nerves then twine around the mesenteric arteries and their branches, and are thus conducted to the intestines, in the internal tunic of which they terminate. (See Anatomy of the Nervous System.) The student may now remove the abdominal viscera. Tie the lower extremity of the œsophagus and the upper end of the rectum, each with two ligatures, and divide these tubes between them: dissect out the vena cava from the liver, cut across the hepatic vessels, the cœliac axis, the superior and inferior mesenteric arteries; and then separate the liver, spleen, pancreas, and alimentary canal, from their connections to the parietes of the abdomen; next clean the surface of the abdominal aorta and vena cava, the right and left kidney, and the renal capsules. The *abdominal aorta* may be now seen to pass into the abdomen, between the crura of the diaphragm, opposite the last dorsal vertebra; it then descends obliquely to the left side, and divides on the body of the fourth lumbar vertebra into the right and left iliac arteries. The abdominal aorta sends off the following branches: 1st, the two phrenic arteries; 2d, the cœliac axis; 3d, the superior mesenteric artery; 4th, the two renal arteries; 5th, the spermatic arteries; 6th, the inferior

mesenteric artery; also four or five pair of lumbar arteries from its posterior part; and lastly, from the angle of its division the middle sacral artery descends. The *right* and *left iliac arteries* descend obliquely outwards and backwards; that of the right side is the longer of the two; opposite each ilio-sacral articulation each common iliac artery divides into the internal and external iliac. The *external* proceeds along the inner side of the psoas magnus, and passing beneath Poupart's ligament, becomes the femoral artery; just above this ligament it sends off two branches, the epigastric and the circumflex ilii. The *internal iliac artery* descends into the pelvis, and gives off several branches, which shall be noticed afterwards in the dissection of that cavity. The veins in the abdomen correspond to the arteries; each *external iliac vein* ascends along the inner side of the artery of the same name, and near the sacrum is joined by the *internal iliac vein*, which ascends from the pelvis; the union of these on each side form the *common iliac veins*; each of these ascends behind its accompanying artery, and opposite the right side of the fourth or fifth lumbar vertebra these veins unite and form the inferior or ascending vena cava; the left common iliac vein is longer than the right, and passes behind the right iliac artery. The *vena cava* ascends along the right side of the aorta, and receives the spermatic, renal, and lumbar veins; it lies, inferiorly, on the right psoas muscle, and on the right crus of the diaphragm; superiorly, it inclines forwards and to the right side, and enters the fissure in the liver; here it receives the venæ cavæ hepaticæ; it then passes through the opening in the tendon of the diaphragm, and arrives at the right auricle of the heart. On each side of the abdominal aorta the *sympathetic nerves* may be seen; they pass from the thorax into the abdomen, beneath the true ligamentum arcuatum, and then descend between the crus of the diaphragm and the psoas magnus on each side; in this course they form three or four oval ganglions. At the last lumbar vertebra these nerves pass outwards and backwards, and then descend into the pelvis.

The commencement of the *vena azygos* may be observed on the right side of the aorta; it is formed by the first or second lumber veins, which communicate with the renal and inferior lumbar veins, and sometimes with the inferior vena cava. The vena azygos enters the thorax between the aorta and the right crus of the diaphragm, and then ascends along the posterior mediastinum. The *thoracic duct* also may be seen to commence in the abdomen by the union of several absorbent vessels on the body of the third lumbar vertebra; this vessel, being larger here than it is above, has received the name of *receptaculum chyli*: this, however, does not always exist. The thoracic duct is covered at first by the aorta, it then ascends obliquely to the right side, and enters the thorax between the aorta and vena azygos. Let the student next examine the urinary organs; these consist—1st, of the kidneys, which secrete the urine; 2d, of the ureters, which convey this fluid to 3d, the urinary bladder, which retains it for a longer or shorter time; and 4th, the urethra, which discharges it externally.

DISSECTION OF THE KIDNEYS AND URETERS.

Each *kidney* is situated in the posterior part of each lumbar region, behind the peritonæum, between the last rib and the crest of the ilium; and corresponds

to the two last dorsal and two first lumbar vertebræ; the right kidney is often a little lower than the left, particularly if the liver be larger than usual; they are each imbedded in a quantity of soft adipose substance, and lie on the diaphragm, psoas, and quadratus lumborum muscles; the ascending colon and duodenum lie anterior to the right, and the descending colon to the left kidney; the right is in contact with the liver above, and with the cæcum below; and the left with the spleen above, and the sigmoid flexure of the colon below. The anterior surface of each is convex, the posterior is flat; in the young subject the surfaces are very uneven, the kidneys at that age being lobulated. The external border of each is smooth and convex, and directed outwards and backwards; the concave edge is of much less extent, looks forwards and inwards, and contains the arteries, veins, and excretory duct; the veins are usually, but by no means constantly, anterior; the arteries, five or six in number, are behind these; and the ureter is posterior and inferior to both. The superior extremity of each kidney is larger and nearer to the spine than the inferior. The kidney is partially covered by peritonæum, to which it is but loosely connected; it has also a capsule of cellular and adipose substance, and a strong smooth fibrous tunic, which adheres closely to its substance, preserves its form, and is continued into its interior, along the vessels, as far as the calyces of the kidney. Remove one kidney from the subject, and divide it by a perpendicular incision from the convex to the concave edge, the gland will then be found to consist of two distinct substances, the external or vascular, the internal or membranous. The external, vascular, or *cortical substance*, forms a covering for the kidney about two lines thick, and sends longer prolongations into the body of the gland; between the tubular fasciculi. The cortical substance is of a dark brown red color, and can be separated into numerous small grains; when injected it seems wholly composed of arteries and veins. Internal to this is the *tubular substance*, which consist of fine vessels of a pale color, and very dense structure; these are arranged in conical fasciculi, about eight or ten in number; the base of each is directed towards the circumference, the apex towards the concave edge of the kidney: the apices of these cones are named *papillæ;* each papilla is perforated by several small holes, through which the urine may be observed to flow when the tubular cones are compressed. The papillæ are surrounded by membranous sacs called *calyces*; each calyx contains one or two papillæ and are five or six in number; they are dense and white, composed externally of a fibrous coat of the kidney, and internally of a fine mucous membrane, which is continued from the ureter along the pelvis of the kidney, lines all the calyces, and is reflected in the form of a very fine membrane over each papilla, and most probably is continued into the tubuli uriniferi. The calyces in each extremity, as also those in the centre unite into three small tubes, which being of a funnel shape, are called *infundibula;* these have but a short course, and soon terminate in the pelvis of the kidney. The *pelvis* is a membranous reservoir formed by the union of the calyces or the infundibula of a flattened-oval figure, placed behind the blood-vessels of the kidney, and terminating in the ureter, which it resembles in structure. Each kidney receives a very large artery (the renal or emulgent) from the aorta: this divides into six or eight branches, which enter the notch in the gland, subdivide into numerous fine vessels, which proceed between the tubular portions to the

cortex, in which they terminate in minute branches, some of which are continuous with corresponding veins, others with the commencements of the tubular fasciculi; these last separate the urine from the blood, and pour it into the tubuli uriniferi, which convey it to the papillæ, through the small pores of which it gradually flows into the calyces, and from these into the pelvis, and so into the ureter. The *ureter* is the excretory duct of the kidney, and extends from it to the urinary bladder; each ureter is about eighteen inches long, and about the size of a goose quill; its coats are very pale, and always appear collapsed. These vessels take an oblique course downwards and inwards to the pelvis; each then inclines a little forwards, continuing still to run downwards and inwards to the inferior and posterior part of the bladder, passes obliquely between the muscular and mucous coats of this viscus; and perforates the latter at the posterior angle of the trigone. Each ureter passes anterior to the psoas magnus, and to the iliac vessels, is covered by the peritonæum, and crossed by the spermatic vessels, and near its termination in the male subject by the vas deferens; and in the female by the fallopian tubes, and broad ligaments of the uterus. In the male each ureter attaches itself to the bladder at the posterior extremity of each vesicula seminalis, and runs for the extent of an inch between the tunics of the bladder, and opens internally (as will be seen hereafter in the dissection of the pelvic viscera) about an inch and a half from the commencement of the urethra, and about the same distance from its fellow. In the female the pelvic portion of each ureter is longer than the male; they also lie at a greater distance from each other, and perforate the bladder nearer to its neck than in the male subject. The ureter is composed externally of a fibrous coat and internally of a pale mucous membrane; it is surrounded by cellular tissue, and in some situations is partially covered by peritonæum. The ureters are larger at their commencement, and smaller at their termination; the intermediate portion of each is nearly of one uniform diameter.

Attached to the upper extremity of each kidney is a small gland-like substance, named *renal capsule*, or *supra-renal*, or *atrabiliary body;* of a crescentic shape, the base attached to the kidney by cellular membrane and by small blood-vessels; these organs lie on the diaphragm, and on the semilunar ganglion of each side, and are covered, that on the right side by the vena cava and duodenum, and on the left by the spleen and pancreas; a vein also runs along their anterior surface. In the interior of each renal capsule we find a small triangular cavity filled with a brownish fluid; the walls of this cavity are very rough, no excretory duct can be found leading from it. The exact use of these bodies is not ascertained. The renal capsules in the adult are thin, and of a brownish yellow color; in the fœtus they are very large and vascular, nearly equal to the kidney in size, and contain a quantity of reddish fluid.

The bladder and urethra are the next divisions of the urinary organs to be examined; as these, however, are pelvic viscera, we shall postpone the consideration of them for the present, and the student should next examine the deep muscles of the abdomen, viz. the diaphragm, and the quadratus lumborum, psoas parvus, psoas magnus, and iliacus internus of each side.

DISSECTION OF THE DEEP MUSCLES OF THE ABDOMEN.

Diaphragm is exposed by dissecting off the peritonæum; it separates the abdomen from the thorax, being concave towards the former cavity, convex towards the latter; it may be divided into two portions, a superior broad portion (the true diaphragm) and the inferior lesser portion, or the appendices or crura of the diaphragm. The *superior true diaphragm* is broad, thin, and nearly circular; it *arises* by distinct fleshy fasciculi, from the posterior surface of the xiphoid cartilage, and from the internal surface of the cartilages of the last true, and of all the false ribs; these fasciculi indigitate with those of the transversalis muscle; between the extremity of the last rib and the side of the spine, it arises from the upper part of a strong aponeurosis, which covers the quadratus lumborum muscle; this is the anterior lamina of the tendon of the transversalis; the upper edge of this fascia being very tense, particularly when the 12th rib is everted, and appearing to be extended as a distinct ligament between this bone and the first lumbar vertebra, has received the name of the *ligamentum arcuatum;* it is not a distinct ligament; it may, however, be named the *external* or *false* ligamentum arcuatum, to distinguish it from a true and distinct ligament, which extends from the transverse process of the first to the body of the second lumbar vertebra; this may be named the *true* or *internal* ligamentum arcuatum; its concavity looks downwards, and extends across the upper extremity of the psoas magnus and the sympathetic nerve; from the convex edge of this ligament the diaphragm next arises; from this extensive origin the fibres pass in different directions, the anterior backwards and upwards to the edge of the cordiform tendon, the middle upwards and inwards, and then a little downwards, to the lateral borders of the central tendon, and the posterior fibres pass forwards and upwards to the posterior edge of the tendon; the anterior fibres are the shortest, the lateral are the longest and the most arched, particularly those on the right side, the convexity of which is on a level with the fourth rib; the convexity of those on the left side is on a level with the fifth or sixth rib. The central tendon of the diaphragm is of great transverse breadth, and is divided into three portions, an anterior, right and left; the first is the largest, the last is the smallest; in regard to their relative size these divisions of the tendon are uncertain; the posterior border of the tendon is notched for the insertion of the crura or appendices of the diaphragm; the fibres of this tendon chiefly run in rays from behind, forwards and outwards; they are crossed and interlaced, however, by several bands, which have an irregular direction; this tendon is much stronger and larger in proportion in the old than in the young. Behind and below this tendon are the two crura or appendices of the diaphragm; the right *crus* is longer and thicker than the left, and *arises* by tendinous bands from the forepart of the bodies of the first four lumbar vertebræ. The left is smaller, and on a plane posterior to the right; it *arises* from the sides of the two or three first lumbar vertebræ; the fibres of each crus ascend obliquely forwards, are connected to each other by a semilunar tendinous band extended across the aorta; they then become fleshy, and a small fasciculus is sent from each crus to join the opposite; these decussating fasciculi separate the œsophageal from the aortic opening in the diaphragm; of these fasciculi, that from the

right crus is always the larger, and that from the left is generally, but not always anterior. Each crus then ascends, and is *inserted* into the posterior border of the cordiform tendon. The right crus of the diaphragm is covered by the vena cava, renal capsule, semilunar ganglion, and by the liver; the left crus by the aorta, left renal capsule, semilunar ganglion, spleen, and stomach. To the thoracic surface of this muscle the pleuræ are attached laterally, and the pericardium and mediastina along the middle. Three large openings are observed in the diaphragm; one for the aorta, one for the vena cava, and one for the œsophagus. The aortic opening is rather a tendinous passage, behind and between the crura of the diaphragm: it opens into the abdomen opposite the last dorsal vertebra, and nearly in the mesial line; the thoracic duct and vena azygos ascend through it, along the right side of the aorta; the splanchnic nerves, particularly the left, sometimes pass through this opening; but in general these nerves perforate the crura at a little distance from the aorta. The opening for the œsophagus and eighth pair of nerves is superior and anterior to that for the aorta, and is a little to the left of it; it is of an oval figure; its parietes are fleshy, and are formed by the decussating fasciculi from the crura; the origin of these separate the œsophageal from the aortic opening. The opening for the vena cava is situated at the back part of the right division of the tendon, anterior to the insertion of the right crus; this foramen is perfectly tendinous; it is somewhat quadrilateral, and appears larger than the vein; the edges are attached to the vessel, and prolonged upon its coats; the anterior margin being continued on the abdominal portion, and the posterior margin on the thoracic portion of the vein. Posterior to the ensiform cartilage there is a small triangular space on each side, where the diaphragm is deficient, and through which the peritonæum is connected to the pleura and pericardium; through this space also the cellular membrane in the mediastinum is continuous with that between the abdominal muscles. *Use*, it is the principal muscle in inspiration: by its action it enlarges the thorax in the perpendicular direction, for the contraction of the crura draws down the cordiform tendon, and fixes it; and then, when the fibres of the superior diaphragm contract, they descend, and instead of being convex towards the chest they become nearly straight, so as to present a plane surface to the abdomen, looking downwards and forwards. As the fleshy fibres are longest at the sides, it is here the greatest descent in the muscle occurs, consequently the thorax is most enlarged on each side beneath the lungs. When the diaphragm relaxes, its elasticity and the connection of the pleuræ and pericardium to its superior surface, cause it to re-ascend, so as to present a concave surface to the abdomen, and so diminish the capacity of the thorax. The diaphragm also assists in coughing, laughing, speaking; also in the expulsion of urine and fæces, and in the various exertions of the body. The student may now re-consider the different muscles which assist, and which oppose the diaphragm in respiration; by this term we mean the act of taking into the lungs a certain quantity of air, and the subsequent expulsion of it from these organs; the former is termed inspiration, the latter expiration. Inspiration requires greater muscular efforts than expiration, which is chiefly effected by the relaxation of the muscles of inspiration, and by the elasticity of the parietes of the thorax. Inspiration may be performed with two different degrees of force; the first, in which there is little muscular effort, is called ordinary

inspiration; the second, in which there is great exertion, is called full inspiration. In the first, the diaphragm and the intercostal muscles are employed, but chiefly the former; and in the second, several additional muscles assist, viz. the scaleni, the subclavian, the serrati postici; also by fixing the superior extremities, the pectoral, serrati magni, and latissimi dorsi muscles exert considerable power, in elevating the ribs and drawing them outwards, so as to enlarge the chest transversely, and from before backwards.

Expiration also may be performed in the same different degrees of intensity; in the first or ordinary degree, the elasticity and slight contraction of the abdominal muscles press the viscera against the diaphragm, which is already receding in consequence of its own relaxation, and the elasticity of the parts attached to its thoracic surface: when expiration is performed in the second, or forced degree, the elasticity of the ribs and of their cartilages opposes the intercostal muscles; the triangulares sterni also depress the cartilages, and the abdominal muscles and levatores ani, by increasing their contracting force, push the abdominal viscera against the diaphragm, and draw down the ribs; the serrati postici inferiores and quadrati lumborum muscles assist, also the latissimi dorsi muscles, by acting towards the ilium; and should the last rib be fixed, it is possible for the intercostal muscles to depress the superior ribs, and so to become muscles of expiration.

Quadratus Lumborum, is a thick, flat muscle, between the anterior and middle layers of the transversalis abdominis tendon, posterior to the psoas, the kidney and the diaphragm; and anterior to the sacro-lumbalis; it *arises* tendinous from the posterior fourth of the spine of the ilium, and from the ilio-lumbar ligament; the fibres ascend obliquely inwards, and are *inserted* into the extremity of the transverse processes of the first four lumbar vertebræ, and of the last dorsal; also into the internal surface of the posterior half of the last rib. *Use;* to bend the spine to one side, to depress the last rib, thus assisting in expiration; when both muscles act, they support the spinal column in the perpendicular direction.

Psoas Parvus *arises* fleshy from the side of the last dorsal and first lumbar vertebra, ends in a long flat tendon, which descends on the inner side of the psoas magnus, and is *inserted* broad and thin into the linea ileo-pectinæa, or brim of the pelvis, also into the fascia iliaca and fascia lata, behind the femoral vessels. *Use;* it assists in bending the body forwards, or in raising the pelvis; it also makes tense the crusal arch, in consequence of its attachment to the fascia lata. This muscle is often wanting; when present, it is situated internal and anterior to the psoas magnus, and is partly concealed by the diaphragm, the renal vessels, the peritonæum, and at its insertion by the external iliac artery.

Psoas Magnus, long, round and thick in the centre, small at its extremities, fleshy at its superior, tendinous at its inferior; it extends along the sides of the lumbar vertebræ, of the brim of the pelvis, and the anterior and inner part of the thigh; it *arises* fleshy from the side of the body of the last two dorsal, and from the bodies and transverse processes of all the lumbar vertebræ, also from the intervertebral ligaments; the fibres all descend, at first vertically, afterwards obliquely outwards, along the brim of the pelvis, and beneath Poupart's ligament; the muscle then becomes tendinous, and descends obliquely inwards and backwards, and is *inserted* tendinous into the

back part of the lesser trochanter, also fleshy into a ridge below that process. *Use;* to flex the thigh on the pelvis, or the body on the thigh; it also rotates the thigh outwards; in standing it supports the spine, and prevents it bending backwards, and in walking it is particularly engaged; it then raises, throws forwards and outwards the lower extremity. This muscle is situated between the psoas parvus and the quadratus lumborum above, and between the former muscle and the iliacus below; and in the groin, between the sartorius and the pectinæus: its insertion is between the vastus internus and the pectinæus; it is covered in the lumbar region by the diaphragm, the kidney, and its vessels; also on the right side by the vena cava, and on the left by the aorta; in the middle or pelvic division of its course it lies between the external iliac vessels and the iliac muscle and the anterior crural nerve; in its lower or inguinal division it is partly covered by the femoral artery and nerve, and by some of their branches, also by the inguinal glands, and by a considerable quantity of cellular membrane. The psoas lies anterior to the transverse processes of the lumbar vertebræ, to the quadratus lumborum, the lumbar nerves, the inner edge of the iliacus internus, and the capsular ligament of the hip; the lumbar nerves or the lumbar plexus in general run through the psoas, perforating its posterior portion; a large bursa separates its tendon from the pubes and from the capsular ligament; this bursa sometimes communicates with the synovial membrane of the hip joint. A smaller bursa lies between the point of the lesser trochanter and this tendon. The tendon of the psoas is formed in the outer or iliac side of the muscle, and receives the insertion of the fibres of the iliacus internus.

Iliacus Internus, flat, or concave, radiated or triangular, *arises* fleshy from the transverse process of the last lumbar vertebra, from the inner margin of three anterior fourths of the crest of the ilium, from the two anterior spinous processes, and from the intervening notch, from the brim of the acetabulum, and from the capsular ligament, also from the iliac fossa, and from the strong aponeurosis, the iliac fascia, which covers it. The iliac fascia is attached to the crest of the ilium, to Poupart's ligament, as far inwards as the iliac artery, behind which it passes and becomes continuous with the pubic portion of the fascia lata; the fibres of this muscle all descend obliquely inwards, join the outer side of the tendon of the psoas magnus, and are *inserted* along with it, or rather into it; the inferior fibres are also inserted into the anterior and inner surface of the femur, below the lesser trochanter. *Use;* to assist the psoas in flexing the thigh, and in rotating it outwards; it also abducts it; it protects the fore part of the capsular ligament, and inflexion of the thigh draws it out of the angle between the neck of the femur and the edge of the acetabulum.

This muscle fills up the concavity of the iliac fossa; on the right side it is covered by the cæcum, on the left by the colon; in the groin this muscle is partly covered by the sartorius, and it lies on the rectus and on the capsular ligament. We may next proceed to the dissection of the perinæum and the viscera of the pelvis.

§ 4.—*Dissection of the Perinæum in the Male.*

Place the subject on the back, bend the thighs and knees upon the trunk,

and secure them in the same position as if you were about to perform the lateral operation of lithotomy; the dissection will be facilitated if the pelvis be raised by a block placed beneath it; moderately distend the lower end of the rectum with sponge or curled hair; introduce a staff or catheter into the urethra and bladder; secure the penis to it by a ligature, and raise up the scrotum. The *perinæum* extends from the os coccygis behind, to the arch of the pubis before; is bounded on each side by the rami of the pubis and ischium, by the tuber ischii, and by the great sacro-sciatic ligament, which extends from that process to the side of the sacrum and coccyx; the glutæus maximus overhangs this ligament; the tuberosity and ramus of the ischium can be felt through the integuments, also (unless the subject be very fat) the ramus of the pubis leading obliquely upwards on each side to the symphysis: the integuments of the perinæum and scrotum are generally of a dark brownish color in the adult, and of a reddish hue in the child; very thin around the anus, and covering the scrotum, but dense in the intermediate space: along the mesial line, a prominent hard ridge is observable, the *raphe* of the perinæum; this line commences in front of the anus, and extends along the perinæum, scrotum and penis, as far as the prepuce of the latter. Dissect off the integuments from this region, and we expose posteriorly a cutaneous muscle (the spincter ani) surrounding the anus, and anteriorly a strong fascia covering the muscles of the perinæum, the crura penis, and the corpus spongiosum urethræ.

Sphincter Ani is flat, thin, oval, pale, and open in the middle; it *arises* from a ligamentous substance, which extends from the os coccygis to the rectum; the fibres descend obliquely forwards, expanding on either side nearly as far outwards as the tuberosity of the ischium; at the posterior part of the anus this muscle divides into two fasciculi, which pass, one at each side of this opening, and unite at its anterior part, thus encircling this orifice; *inserted* into the raphe in the integuments, and into the superficial fascia; a fasciculus of it also perforates the latter, and is inserted into the common central point of the perinæum; a point which will be more fully seen when the fascia shall have been raised. *Use;* to close the anus; it may also draw downward the bulb of the urethra; this muscle is almost constantly in a state of contraction, and, like all the sphincter muscles, belongs to the class of mixed muscles. One of its surfaces looks upwards, the other downwards; one edge is internal, the other external. It is superficial; its lateral extent is much greater in some subjects than in others; a few of its external fibres are divided in the first incision in the lateral operation of lithotomy;—beneath and internal to this muscle we may expose the following, with very little dissection.

Sphincter Internus, *vel* Orbicularis, consists of a thick, but pale fasciculus of muscular fibres, which encircles the lower extremity of the rectum, having no attachment to the coccyx behind, and but a slight one to the central point before: it is in close contact with the mucous membrane of the intestine; its *use* is similar to that of the last described muscle. Its surfaces are internal and external, its edges superior and inferior. Anterior to, and on each side of the anus, we find beneath the integuments a condensed cellular texture, covering the other muscles in the perinæum; this is the *superficial fascia;* it is continued from the inner side of one thigh across the perinæum to the opposite, adhering to the rami of the ischium and pubis on each side,

by tendinous fibres; this fascia is very dense about the middle of the perinæum; posteriorly, on either side of the anus it is loaded with soft large grained adipose substance: anteriorly it extends over the scrotum, and becomes thin and fine, like reticular membrane, and continuous with the superficial fascia from the abdomen. This fascia covers the vessels, and all the muscles of the perinæum, except the two sphincters of the anus. Separate this fascia from one side of the perinæum, and reflect it towards the opposite; its density and close connection to the lateral boundaries of this region will then become obvious; a number of veins and nerves, and a quantity of fat also will be observed; when the latter is dissected away, those muscles of the perinæum, which are attached to the penis and urethra, will appear covered, however, by a fine but dense aponeurosis, which may be next dissected off: these muscles are six in number, three on each side, viz. the erector penis, transversalis perinæi, and accelerator urinæ* If the perinæum be divided by a transverse line drawn from one tuberosity of the ischium to the other, into an anterior and posterior part, we shall find that the anterior triangular space contains the six muscles just named, also the crura penis and the corpus spongiosum urethræ: the posterior triangular division contains the lower extremity of the rectum, surrounded by the cutaneous and deep sphincters, also on each side of this intestine a considerable quantity of fat filling up the space between the side of the rectum and the obturator internus muscle and fascia, which space is bounded superiorly, that is, separated from the pelvis by the levator ani muscle, and inferiorly is closed by the fascia and integuments; the fat is from two to three inches in depth; when this mass is dissected out of the space which it fills, the levator ani muscle will be seen extended from the internal surface of the pelvis to either side of the rectum, and to the coccyx, so as to form a partition between the pelvis and the perinæum.—First examine the muscles in the anterior part of the perinæum; the erector or compressor penis is most external, and lies on the crus penis: the accelerator urinæ extends along the middle of the perinæum, attached to its fellow along the raphe, and covering the urethra; the transversalis perinæi connects the posterior extremities of these muscles. Immediately in front of the rectum, in the middle line, and behind, but connected to the bulb of the urethra, is a small, white, tendinous spot, composed of condensed cellular tendinous substance; into this many of the perinæal muscles are inserted; it is, therefore, called the *central point* of the perinæum, or the *common point* of insertion to the muscles of the perinæum.

Erector, or Compressor Penis, long and flat, narrow at each extremity, broader in the middle, *arises* tendinous and fleshy from the inner surface of the tuber ischii, and from the insertion of the great or inferior sacro-sciatic ligament, the fibres proceed forwards, upwards, and inwards, adhering to the edges of the rami of the pubis and ischium, and covering the crus penis. The fleshy fibres terminate in a tendinous expansion, which inclines forwards, upwards, and outwards, and is *inserted* into the fibrous membrane of the corpus cavernosum or crus penis. *Use;* to draw down the penis; it also contributes to the erection or distension of this organ by propelling the blood into it, and

* A knowledge of these fasciæ will explain the resistance which this structure presents to collections of urine or of pus from coming to the surface.

by the compression of the veins against the bone preventing the free return of this fluid through these vessels.

Accelerator Urinæ, or Ejaculator Seminis, is in the middle of the perinæum, extends from the front of the rectum to the back part of the scrotum, and is attached to its fellow along the mesial line; it *arises* first, by tendinous fibres from the triangular or inter-osseous ligament, internal to the erector penis: secondly, by a broad tendon, which is common to the opposite muscle, and which lies above the urethra, between it and the pubis; thirdly, more anteriorly by a tendinous expansion from the side of the corpus cavernosum penis. The posterior and middle fibres descend inwards; the anterior fibres, which are longer, descend obliquely backwards and inwards; all the fibres are *inserted* along with those of the opposite muscle into the middle tendinous line or raphe of the perinæum, which extends from the central point to the back of the scrotum.—*Use*; to expel the last drops of urine and semen, also to distend the corpus spongiosum urethræ by propelling the blood into its cells. The posterior origin of this muscle is overlapped by the erector penis, and by the perinæal vessels and nerves; the origin of the middle fibres lies above the urethra, and that of the anterior is external to the crus penis. The anterior fibres of this pair of muscles, by converging towards the middle line, resemble the letter Y. The acceleratores urinæ muscles fill up the middle of the perinæum, cover the bulb, and encircle the urethra anterior to it. Separate these muscles from each other along the mesial line, and detach one of them from the corpus spongiosum urethræ; then by examining its deep surface, its origin, particularly that which lies above the urethra, anterior to the bulb, will be more distinctly seen.

Transversalis Perinæi, is thin and weak, often indistinct, and sometimes wanting; it *arises* from the inside of the tuberosity of the ischium, the fibres pass transversely inwards and a little downwards, and are *inserted* into the central point of the perinæum, behind the accelerator urinæ muscle. *Use*, to fix the central point, and support the anus; it may also dilate the bulb. This muscle is covered by the sphincter ani, and by the superficial fascia, a small artery (transversalis perinæi) runs along its anterior edge; it lies on the levator ani, is connected to it by cellular membrane, and in some cases is intimately joined to it. In some subjects a second muscle may be observed taking a transverse course (the *transversalis alter*): this *arises* from the ramus of the ischium, proceeds obliquely forwards and inwards, and is *inserted* into the accelerator urinæ. These muscles are very irregular in size in different persons, in some being found very distinct and strong, in others a few pale and scattered fibres only point out their course and situation. Between the three last described muscles on each side, we may remark a triangular space, which is bounded externally by the crus penis and the erector penis muscle, internally by the urethra and accelerator urinæ; the base is posteriorly, and is formed by the transversalis perinæi muscle. This space contains a quantity of fat, also the perinæal artery, veins, and nerves, branches of the pudic vessels and nerves; into this space, on the left side of the perinæum, the operator must sink his knife in the lateral operation of lithotomy, in order to lay bare the groove in the staff. In this incision the transversalis muscle and artery of the perinæum must be divided. Next dissect off the erector penis from the crus penis, also the acceleratores urinæ muscles from the bulb

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and corpus spongiosum urethræ; detach the transverse muscle from its attachments, and remove the vessels and cellular membrane out of the triangular space just now described; then press the bulb of the urethra to one side from the crus penis, and between these two bodies we may observe a strong ligamentous substance, the fibres passing in different directions; this is the *triangular ligament of the urethra* or the *inter-osseous ligament of the perinæum.* The apex of this ligament is above, and is weak and cellular, being lost in front of the symphysis pubis, on the dorsal vessels of the penis; the sides are connected to the rami of the pubis and ischium; its base is directed towards the rectum, being connected in the middle line to the central point of the perinæum on each side of which it is thin and weak, and gradually lost on the surface of the levator ani. Through this ligament the urethra passes about an inch below the inferior edge of the symphysis pubis, and as this canal passes through it, the ligament sends a lamina on it in each direction, one anteriorly on the bulb the other posteriorily on the membranous portion of the urethra and prostate gland; the former is called the anterior, the latter the posterior layer of the triangular ligament, and are separated from each other by Cowper's glands and the artery of the bulb. The *anterior layer of the triangular ligament* is expanded on the bulb, and gives to it the peculiar glistening appearance it now presents; it also retains it in its situation, and prevents it being detached, as will appear if you endeavor to draw it out of its place. The *posterior layer* is continued backwards around the membranous part of the urethra to the prostate gland, the capsule for which it forms, and then becomes continuous with the reflections of the pelvic fascia on the neck of the bladder. Divide a few fibres of the anterior layer of this ligament, and by a little dissection you will expose on each side of the bulb a small glandular body, *Cowper's* or the *anti-prostatic glands*; these are two in number, about the size of a small pea, situated at each side of, and behind the bulb, below the membranous part of the urethra, between the layers of the triangular ligament, and closely connected to the artery of the bulb; they are covered anteriorly by the acceleratores urinæ muscles, and by the anterior layer of the triangular ligament; from each a small delicate duct, about an inch in length, passes forwards, opens obliquely into the lower and lateral part of the urethra, at a little distance anterior to the bulb. Dissect away all the cellular membrane at the side of the rectum, between it and the tuber ischii; you will thus expose the greater portion of the levator ani muscle; press the rectum to the opposite side, and you will then observe how this muscle, posteriorly, and the triangular ligament, anteriorly, close the inferior opening of the pelvis, and separate this cavity from the perinæum. Divide the triangular ligament on one side from the rami of the pubis and ischium, and draw it over towards the bulb of the urethra, which, together with the rectum, press or fasten with a tenaculum, towards the opposite tuberosity of the ischium. In separating this ligament from the bone, the pudic artery and its terminating branches will be seen; we thus also expose more fully the levator ani muscle.

Levator Ani, flat, thin and broad, situated at the inferior part of the pelvis, broader above at its origin than below at its insertion; *arises* fleshy from the posterior part of the symphysis pubis below the true ligaments of the bladder; thin and tendinous from the obturator fascia, and from the ilium above the thyroid hole; thick, tendinous, and fleshy from the inner surface of the ischium,

and from its spinous process; the fibres descend obliquely inwards, by the side of the neck of the bladder and rectum; the anterior passing more backwards than the others, while the posterior are more transverse or horizontal, *inserted*, the anterior or pubic fibres into the central point of the perinæum, and into the fore-part of the rectum, uniting with the fibres from the opposite side. These anterior fibres descend along the side of the prostate gland and the membranous part of the urethra; the middle fibres into the side of the rectum, passing internal to the sphincters, and united to the outer surface of the longitudinal fibres of the intestine; the posterior fibres into the back part of the rectum, and into a tendinous raphe, extending from it to the os coccygis, in which raphe the muscles from opposite sides unite, also into the two last bones of the coccyx. *Use*, to raise the rectum when this intestine has been protruded by the efforts of the abdominal muscles to expel its contents; it also assists in closing this intestine, it compresses the vesiculæ seminales and prostate gland; the anterior portion supports the perinæum by raising the common central point, and may also compress and close, like a sphincter, the membranous portion of the urethra; the levator ani completes the inferior boundary of the pelvis and abdomen, and is opposed to the diaphragm in respiration, being a muscle of expiration. The two levatores ani muscles resemble a funnel, with two openings in it inferiorly: the concavity directed towards the pelvis, the convexity to the perinæum; through the anterior aperture the urethra passes, through the posterior the rectum. On the perinæal surface of this muscle are placed the muscles, the triangular ligament and the adipose substance of which we have spoken: the pelvic surface of this muscle is covered by the peritonæum and by the pelvic fascia, which cannot be seen in the present dissection, but which shall be noticed presently. At the anterior edge of each levator ani muscle fleshy fibres may be observed to surround the membranous part of the urethra very closely. These fibres, particularly at their insertion, will in general be found so united to the levatores ani, that they may be considered as a portion of these muscles; they have, however, been described by Mr. Wilson as a pair of distinct muscles, under the following names, and to the following effect:

Compressor Urethræ, *arises* by a tendon from the inside of the symphysis pubis, about one-eighth of an inch above the lower edge of the arch, and at nearly the same distance beneath the anterior ligaments of the bladder, to which, and to the tendon of the opposite muscle, it is connected by loose cellular membrane; the tendon is at first round, but becomes flat as it descends and is parallel to and in contact with its fellow; it then ends in fleshy fibres, which increase in breadth, and which, approaching the upper surface of the membranous portion of the urethra, separate from those of the opposite muscle, descend along the side of the membranous portion of the urethra, and folding beneath it, again approach the muscle of the opposite side, and are *inserted* with it into a narrow tendinous line, which becomes lost in the common central point of the perinæum. *Use*, to compress, contract, close, and elevate the membranous portion of the urethra; these fibres encircle the narrowest part of the urethra, that portion which is just behind the bulb, and may, by their contraction during life, form such an impediment to the passage of an instrument into the bladder, as may lead the surgeon to suspect the presence of a stricture, when in reality no alteration of structure exists. The origin of these muscles are occasionally distinguished from the levatores ani, by some small

veins which pass from the side of the neck of the bladder to join the trunk of the dorsal veins of the penis, but their insertion is confounded with these muscles in perinæo behind the bulb.

Let the student next replace the triangular ligament, &c. and then re-consider the several parts before him, in reference to the operation of lithotomy: he has already examined the triangular space between the erector penis and accelerator urinæ muscles, into which the knife of the operator is to sink in order to reach the groove in the staff; this space has been fully opened, and the staff can be plainly felt or seen passing above the bulb through the membranous part of the urethra into the bladder: behind and below the bulb is the rectum; and close to the rami of the pubis and ischium are the internal pudic vessels: the large artery from the pudic, called the deep transverse artery, or the artery of the bulb, may also be observed passing in the substance of the triangular ligament, about an inch below the symphysis pubis. Hence then, in order to lay bare the staff without injury to the more important parts which surround it, we should endeavour to open the urethra as near to the base of the triangular ligament as possible, as we shall thus be most likely to avoid the artery of the bulb. When the knife of the operator is lodged in the groove of the staff, and shall then be pushed along it into the bladder, the student will now perceive that the posterior layer of the triangular ligament, the anterior fibres of the levator ani, and the left lateral lobe of the prostate gland must be divided; and from this view may also learn that the rectum will be protected from injury if the staff be well raised into the arch of the pubes, its groove turned a little to the left side, and the wrist of the operator depressed, so as to elevate the point of the knife, and thus direct it on into the bladder; as to withdrawing the knife the student may now learn in what direction this can be done with safety and effect, and what parts require to be divided; it is to be withdrawn slowly and steadily in a direction backwards and outwards nearly parallel to the line of the cutaneous incision, the edge so lateralized as to avoid cutting the rectum posteriorly, or the pubic artery externally: in this part of the operation the middle fibres of the levator ani must be divided, also the adipose substance on its perinæal surface. The student may now withdraw the staff from the bladder, and pass it again and again along the urethra into that cavity; he will soon perceive how apt the point of the instrument is to descend into the sinus of the bulb, and the necessity of depressing the handle of the staff, in order to raise the point into the membranous part of the urethra; at the same time he should observe, that the latter is about an inch below the arch of the pubes, and that, therefore, the point of the instrument is not to be too much elevated, otherwise it may lacerate the upper part of the urethra, and injure some large veins that may be found in this situation. The student may now also examine what occupies the space between the urethra and the pubes; immediately above that canal is the upper portion of the triangular ligament, attached to the crura penis; behind this ligament are one or two large veins from the dorsum of the penis, these enter the pelvis along the upper surface of the prostate gland; above these is a smooth dense ligament, the *pubic ligament*, which is attached to the lower edge of the symphysis pubis, and rounds off the angle between the opposite rami.

Posterior to the levator ani and overlapped by the glutæus maximus, is the following small muscle:

Coccygeus, triangular, at the inferior and posterior part of the pelvis, behind and above the levator ani, *arises* narrow from the inner surface of the spine of the ischium, the fibres expand along the inner or lesser sacro-sciatic ligament, and are *inserted*, fleshy and tendinous, into the extremity of the sacrum and side of the coccyx: *Use*, to support the os coccygis and to assist in closing the inferior and posterior parts of the pelvis; this muscle is between the levator ani and the glutæus maximus; it is more distinctly seen within the pelvis.

Next let the student divide the central point of the perinæum, separate the rectum from the bulb, and draw the former a little downwards from the bladder and prostate gland; he will thus expose the inferior or posterior surface of the neck of the bladder, the flat posterior surface of the prostate gland, also the vesiculæ seminales, the terminations of the vasa deferentia, and the commencement of the urethra, but the most important part to direct the attention to, is a small triangular space or portion of the bladder, just above and behind the prostate gland, which is bounded on either side by the vasa deferentia and vesiculæ seminales posteriorly by the cul de sac of the peritonæum, and anteriorly by the prostate gland which forms the apex of this triangle; within this space the muscular coat of the bladder is in contact with the rectum, and from the cavity of the latter the former organ may be perforated during life without injuring any important part; this space is about three inches and a half, or four inches from the anus, and is selected by some surgeons as the best situation for tapping the bladder in case of retention of urine, when a catheter cannot be passed though the urethra. The student may now proceed to examine the pelvic viscera; for this purpose, separate the left crus penis from the bone, also the left border of the triangular ligament (if not already done), and detach the levator ani muscle of the left side from the bone; with the hand separate the cellular and aponeurotic bands which lie superior to this muscle; then divide the symphysis pubis, or saw the left os pubis about half an inch external to the symphysis, divide the left ilio-sacral articulation, cut through the psoas muscle and iliac vessels, and then remove the os innominatum and lower extremity of the left side; the pelvic viscera will remain in the concavity of the sacrum and of the opposite os innominatum. These viscera will be rendered more distinct by a little dissection, first, moderately inflating the bladder through the ureter, a ligature having been tied around the penis, the rectum also may be moderately distended with curled hair or a sponge, and attached to the spine by a ligature. The *pelvic portion* of the *peritonæum* should be first attended to; this membrane may be now seen to descend along the sides and fore-part of the rectum to within about four inches of the anus, whence it is reflected on the lower and back part of the bladder; the line of this reflection is, in the recumbent position of the subject, opposite the lower margin of the third piece of the sacrum; in the erect posture it will be found on a level with the junction of the sacrum and coccyx; the peritonæum is reflected on the bladder between the middle of the vesiculæ seminales, it then ascends on the back part and sides of this organ to its superior fundus, whence it is continued to the abdominal muscles; below the line of its reflection on the bladder, or below the cul de sac, we may again take notice of the triangular space on the inferior fundas of the bladder, before alluded to as the situation in which that viscus can be punctured from the rectum, in case of retention of urine. The reflections of the peritonæum from

each side of the rectum to the back part of the bladder, are called the posterior ligaments, and the fold which this membrane forms on each side between the bladder and the iliac fossa are named the lateral ligaments of the bladder; these shall be more particularly noticed presently. Remark, the curved course of the rectum, its dilatation near the anus, also the connections of the peritonæum to its upper and middle thirds, and observe that the lower third of this intestine is completely below and unattached to this membrane. Next study the connections of the urinary bladder.

Vesica Urinaria, when contracted, is situated in the anterior and inferior part of the pelvis behind and below the pubes; when distended it occupies more or less of the hypogastric region; when contracted, it appears of a flattened triangular form, the base towards the rectum, the apex behind the lower edge of the symphysis pubis; when distended, it presents an oval figure, the larger end towards the rectum, the smaller and anterior end towards the recti abdominis muscles, between the pubes and the peritonæum; the axis of the bladder is a line directed through its cavity from one extremity to the other; the posterior end of this line, if produced, would touch the extremity of the coccyx, and if continued anteriorly it would reach the linea alba, midway between the pubes and the umbilicus. In the very young subject, the bladder is of a pyriform figure, and is principally lodged in the hypogastric region. The bladder is connected to the parietes and to the viscera of the pelvis by folds of the peritonæum, and by the reflections of the pelvic fascia. The folds of the peritonæum are termed false ligaments, and are five in number, viz. two posterior, two lateral, and one superior: the true ligaments are reflections of the pelvic fascia, and are four in number, two anterior and two lateral. We shall first consider the *false ligaments*, or the folds of the peritonæum, which serve to connect the bladder to the pelvic viscera. The *posterior ligaments* of the bladder are two in number, one on each side; they lead from the fore-part of the rectum to the back part of the bladder; each is of a semilunar form, its concavity looking forwards and upwards; in this fold are contained the ureter posteriorly, and the obliterated hypogastric artery anteriorly; between the posterior ligaments the cul de sac of the peritonæum descends. This membrane will be also found thrown into one or two semilunar folds on the posterior surface of the bladder, provided this viscus be in a state of contraction; these disappear, however, when it becomes distended; hence, it may be inferred, that these folds are designed to admit of the more easy distension of this organ. The *lateral ligaments* extend, one on each side, from the lateral regions of the bladder to the iliac fossæ; each contains in its duplicature the vas deferens in the male subject, and the ligamentum teres of the uterus in the female. The *superior ligament* extends from the summit of the bladder to the recti muscles; this portion of the peritonæum is partially reflected over the remains of the urachus and of the hypogastric vessels Detach the peritonæum from the right iliac fossa, and gently draw the bladder and rectum from the pelvis, we shall then observe, that the neck and side of the former are retained in their situation by the reflection of a strong fascia (the pelvic fascia) from the parietes of the pelvis upon this viscus; these reflections are the true ligaments of the bladder. The pelvic fascia may be considered as a continuation of the iliac fascia; it descends from behind the iliac vessels and from the brim of the pelvis, to which it adheres, and lines

the parietes of the cavity as low down as the upper edge, or the origin of the levator ani muscle; here the pelvic fascia divides into two laminæ, between which this muscle is enclosed: the external lamina is named the obturator fascia, the internal the vesical fascia. The *obturator fascia* descends between the obturator internus and levator ani muscles, adhering very closely to the former, and is inserted inferiorly into the great sciatic ligament, into the tuber ischii, and into the rami of the ischium and pubis, where it is continuous with the triangular ligament of the urethra, which ligament thus appears to be the continuation of the obturator fascia, from one side of the pelvis to the other. The *vesical fascia* covers and adheres to the internal surface of the levator ani, lying between it and the peritonæum; this fascia descends anteriorly to the lower edge of the symphysis pubis, and laterally to a level with a line carried from this point round to the spine of the ischium; from the pubes it is reflected on the upper surface of the prostate gland, and on the neck of the bladder, forming the anterior true ligaments of this organ; laterally it is reflected from the pelvis on the side of the prostate, and on the lower part of the side of the bladder, just above the outer edge of each vesicula seminalis, and thus it forms the true lateral ligaments of the bladder; posteriorly the vesical fascia becomes thin and cellular, is attached to the side of the rectum, and lost on the nerves and vessels passing into and out of the pelvis. The vesical fascia thus forms a pouch on each side of the bladder, which assists in closing the pelvis; it also fixes the pelvic viscera, supports the peritonæum, and resists the pressure of the abdominal muscles and diaphragm. This fascia is perforated by several blood-vessels.

The anterior ligaments of the bladder are two in number; they *arise*, each, from the lower margin of the pubis by the side of the symphysis; pass backwards and upwards on the upper surface of the prostate gland, and expand on the anterior part of the bladder; many of their fibres may be seen to become continuous with the muscular fibres of the bladder. A depression exists between these two ligaments, along with the dorsal veins of the penis pass from beneath the arch of the pubes to the side of the bladder in their course to the internal iliac veins, in which they terminate; the pelvic fascia, however, is not deficient between these ligaments, but is continued from one to the other, so as to line this depression and cover the superior surface of these veins. The true lateral ligaments of the bladder are, one on each side; each is continuous with the anterior ligament, and is formed by the reflection of the pelvic fascia from the inner surface of the levator ani to the side of the prostate gland and of the bladder.

The superior and anterior extremity of the bladder is sometimes named the superior fundus; the posterior extremity, which presses against the rectum, the inferior fundus; the intervening portion is called the body, and that part which is connected to the pubes the cervix; the latter is surrounded by the prostate gland, very little, however, of this gland being above it. The cervix presents somewhat a conical figure; and in the adult lies nearly horizontal, below and behind the pubes; in the child it is more vertical. If the bladder be moderately distended it will be found to present six regions, on each of which some important object may be noticed. 1st, The *superior region*, is in contact posteriorly with the convolutions of the small intestines, and anteriorly with the recti abdominis muscles; to it are attached the urachus and

obliterated umbilical arteries; posterior to these this region is covered by the peritonæum, whereas anterior to them this membrane is deficient. If the bladder be much distended, this region is sometimes found to incline to the left side. 2d and 3d, The *lateral regions*, are contiguous to the sides of the pelvis, to the vesical fascia, and to the levatores ani muscles: descending obliquely backwards along this region on each side, we find the vas deferens crossing over the obliterated umbilical artery above, and over the ureter below, thus passing internal to both, or nearer to the mesial line; the peritonæum adheres to so much of each lateral region of the bladder as lies posterior to the vas deferens while that portion anterior to it is deficient of this serous covering. 4th, The *anterior region* is behind the recti muscles, the pubes, the pubic ligament, and the triangular ligament of the urethra; all this region wants the peritonæal covering; towards its inferior part we observe the anterior ligaments of the bladder, between them the dorsal veins of the penis, and below them the neck of the bladder surrounded by the prostate gland. 5th, The *posterior region* is contiguous to the rectum in the male, to the uterus in the female, and in either sex occasionally to the convolutions of the small intestines; all this region is covered by peritonæum. 6th, The *inferior region*, in the female, lies on the ureters and on the vagina; in the male, on the vesiculæ seminales, the intervening cul de sac of peritonæum, the rectum, and the prostate gland; the superior and posterior part of this region is covered by the peritonæum; but anterior to the line of the reflection of this membrane, from the bladder to the rectum, is the triangular portion of this region, in which the peritonæum is deficient, and which has been already attended to, as the situation in which the operation of tapping the bladder from the rectum may be performed.

The coats of the bladder are four, viz. 1st, the serous, or peritonæal; 2d, the muscular; 3d, the cellular; 4th, the mucous: the *serous* is but a partial coat, it covers all the posterior surface, the posterior part of the upper and lower fundus; also the posterior part of each side. All the anterior region, the fore-part of the sides, and of the upper and lower regions, are therefore uncovered by peritonæum; when the bladder is distended there is more of this organ in proportion covered by this membrane than in its contracted state. The peritonæal covering of the bladder is very dense, it may be easily dissected off the following. 2d, The *muscular* coat consists of fibres which are stronger and redder than the muscular fibres on any of the other hollow viscera; they take different directions; those of the superficial layer run chiefly in a longitudinal direction, are connected anteriorly and inferiorly to the anterior ligaments of the bladder, and superiorly to the urachus, posteriorly and inferiorly to the base of the prostate gland; these fibres are stronger on the anterior and posterior surfaces than on the sides of the bladder: on the latter regions they run obliquely. The anterior fibres, from having a fixed attachment, are called by some the *detrusor urinæ* muscle: the deep fibres mostly take a circular direction, are weak superiorly, but strong near the cervix, where they are supposed to act as a sphincter muscle; these circular fibres which have received this name, may be more distinctly seen by everting the bladder, and dissecting off the mucous membrane near the orifice of the urethra behind the uvula. At the anterior part of the inferior region there is a compact layer of white dense fibrous substance, into which the muscular

fibres of the bladder are inserted, but which itself does not appear to be muscular except near the cervix; this structure will be found to correspond with a particular region, which will be noticed presently in the interior of the bladder, and which is called the trigone, or the velum. Beneath the muscular is the third, or the *cellular coat;* it invests the whole organ, is very elastic, and seldom contains any adipose substance. Open the bladder by a perpendicular incision through its anterior part; and the fourth, or the *mucous coat,* will be observed; this is pale, and thrown into many folds, particularly if the bladder had been empty, for this membrane has no contractile power; through it the muscular fibres project, presenting the reticulated appearance, and very frequently the mucous membrane forms pouches, or small sacks, between these: inferiorly is seen the orifice of the urethra; it is somewhat of a crescentic figure, a small tubercle (the uvula) projecting into it from below: posterior to this the mucous membrane presents a smooth and dense appearance throughout a small triangular space called the *velum* or *trigone;* at the posterior angles of this space the orifice of each ureter may be observed, the line extending between these forms the base of this triangle; this line is somewhat semilunar; the sides of the trigone are defined by lines drawn from each ureter to the uvula; each is from an inch to an inch and a half in length; beneath the membrane covering each of these lines pale muscular fibres may in general be found; these have been named by Mr. Bell, the *muscles of the ureters,* who describes each as *arising* from the vesical extremity of the ureter, and thence descending obliquely forwards and inwards, to be *inserted* by a tendon common to its fellow into the uvula. The use which he assigns to them is, to restrain the termination of the ureters, and preserve the obliquity of the passage of these tubes through the coats of the bladder when it is contracted; for, says he, without this provision the urine would be sent retrogade into the ureters, instead of forward into the urethra. These lines, however, seldom present this structure so distinctly as has been described, and how far their supposed use is correctly ascribed to them is very questionable. The *uvula* of the bladder is a small eminence at the apex of the trigone, much better marked in some than in others; it is merely a thickening and peculiar organization of the sub-mucous tissue; it is nearly opposite, but a little anterior to the third or middle lobe of the prostate gland. The trigone is the most sensible and vascular part of the bladder: posterior to the trigone the bladder is frequently, particularly in old subjects, dilated into a sort of pouch. In the female the trigone is smaller, but broader in proportion than in the male, and the uvula is less distinct. The urethra is the next division of the urinary organs to be examined; as this canal, however, in the male, is the common passage for the urine and seminal fluid, or as it is a part both of the urinary and generative organs, we shall postpone the description of it until we have considered the latter. The organs of generation in the male are the testicles and their appendices, the vesiculæ seminales, the prostate, and antiprostatic glands, (the latter have been already examined,) the penis, and the urethra. We shall describe these organs in the following order: 1st, the testes, with their coverings; 2d, the vasa deferentia; 3d, the vesiculæ seminales; 4th, the prostate gland; 5th, the penis; and 6th, the urethra.

DISSECTION OF THE ORGANS OF GENERATION IN THE MALE.

1st. THE *testes;* these two glands are, in the very young fœtus, contained in the abdomen beneath each kidney; a short time, however, previous to birth, they descend into that situation which they are found to occupy in the adult, and are surrounded by several tunics, viz. the scrotum, dartos, superficial fascia, tunica communis, tunica vaginalis, and tunica albuginea.

The *scrotum* is a process of common integument continued from the inner side of each thigh, and from the perinæum and penis; it is generally of a dark brown color, thinly covered with hair, and very rugged, being thrown into numerous rugæ, it is so thin that the small sub-cutaneous veins and sebaceous follicles can be seen through it; the prominent hard ridge or raphe is continued from the perinæum along its middle line as far as the penis. The *dartos* is the cellular tissue immediately subjacent to the skin, it usually presents a reddish appearance, a number of small vessels being distributed through it; its texture is very loose, and is readily distended in emphysema or in anasarca; it never contains any fat; it is somewhat more dense in the mesial line than at either side. The dartos is connected to the rami of the pubis and ischium of each side, and to the raphe in the middle, thence it ascends between the testes to the urethra, and thus assists in forming the *septum scroti.* The dartos manifests during life a degree of contractility above that which the cellular tissue enjoys in any other situation; it has therefore been considered by some as a cutaneous muscle; this idea is probably incorrrect, although it certainly possesses the power of corrugating the skin, distinct from that rolling motion of the testicle produced by the cremaster muscle; posteriorly the dartos frequently appears to derive a few muscular fibres from the sphincter ani. The *superficial fascia* of the scrotum is continued from that of the abdomen around each spermatic cord and testicle; it is thin and loose, and becomes continuous with the fascia of the perinæum: as this fascia envelopes the cord and testis on each side, it assists the dartos in forming the *septum scroti,* and so retains each testicle at its own side. The *tunica communis* is composed of the expanded fibres of the cremaster muscle and of fine connecting cellular membrane; this tunic surrounds the cord and testis; the fibres of the cremaster are expanded chiefly on the fore-part and sides of the testis. The *tunica vaginalis* was originally a process of the peritonæum, having been prolonged along the cord and around the testicle as the latter was descending from the abdomen to the scrotum; at this early age, the tunica vaginalis in the scrotum communicated with the general cavity of the peritonæum by a sort of canal which led along the fore-part of the cord from the abdomen to the scrotum: this canal, however, about the period of birth was closed by adhesive inflammation, and ever afterwards the cavity of the tunica vaginalis is quite distinct from that of the peritonæum. The tunica vaginalis, therefore, is a serous membrane, a shut sac, suspending, and partly enclosing the testicle, and also reflected over its anterior part and sides: that portion of it which suspends the gland, and which lines the scrotum, may be named the tunica vaginalis *scroti;* while the reflected portion which covers the sides and the fore-part of the testicle is the tunica vaginalis *testis.* This membrane is so loosely connected to the scrotum that it can be detached form

it with little force; it is thence reflected on the side and fore-part of the epididymis and testis; it also ascends a short distance on the fore-part of the cord; the posterior part of the epididymis is altogether uncovered by it: as it is continued from the epididymis to the testicle it passes in between these organs, particularly on their outer side, so as to form a sort of pouch between them. Both the testicle and epididymis are in reality behind this serous membrane, and nothing is contained within its cavity except the serous fluid, which lubricates its opposed surfaces, and which facilitates that gliding motion which the testicle undergoes in the scrotum. When the anterior part of the tunica vaginalis is divided, we see its internal surface smooth and polished, and shining through its reflected layer which covers the testis, we can discern the next tunic of this gland, *tunica albuginea*: this is a dense fibrous membrane; it forms the proper capsule of the gland, adheres to it, preserves its peculiar form, and sends several processes or septa into the testicle, which will be seen when the body of the latter shall have been opened; it has no connection to the epididymis: it is difficult to dissect off the reflected layer of the serous membrane, or the tunica vaginalis testis from the tunica albuginea they are so intimately united; through the latter several blood-vessels can be distinctly seen. Each *testicle* is of an oval form, flattened on each side, also a little on the back part beneath the epididymis; it is suspended rather obliquely, the superior extremity being directed forwards and outwards, the inferior backwards and inwards. Bent like an arch, along the posterior surface of each testicle, is the *epididymis*, long and narrow, large above (globus major), narrow in the middle (body), and again enlarged below (globus minor), attached to the testicle above by vessels, and in the rest of its extent by the reflected layer of the tunica vaginalis, closely on the internal, but very loosely on the external or femoral side; from its inferior extremity the vas deferens proceeds, and thence ascends along its internal side. Divide the tunica albuginea anteriorly and we observe the testicle to be composed of a soft greyish pulpy substance, which, when opened out a little, and floated in water, is found to consist of numerous fine tortuous shreds or vessels of delicate texture, loosely connected to each other; some are of considerable length, and with a little care may be drawn out of the gland to the extent of two or three feet; they are placed in packets or fasciculi, which are separated from each other by fibrous bands or septa, which are derived from the tunica albuginea, and which may now be seen to pass in considerable numbers through the gland towards the back part, where they join the *corpus highmorianum*: this name is applied to a long fold or process of the tunica albuginea, which projects into the back part of the gland; it consists of two laminæ, between which the vessels and nerves of the testicle are enclosed: this process is broader above than below, is perforated in the former situation by the excretory ducts of the testicle; to its anterior border and sides are attached the sepimenta or processes of the tunica albuginea before mentioned. From the several collections of small tubes, which are disposed between these bands or septa, about twelve or twenty larger vessels may be seen to proceed nearly in parallel lines towards the back part of the gland; these are the *tubuli recti*; they pierce the corpus highmorianum, and if one lamina of this process be raised off they will be seen entangled with each other, and with the vessels and nerves of the gland: this structure receives the name of *Rete Testis*,

which is therefore placed near the posterior part of the gland, and enclosed between the laminæ of the corpus highmorianum; from the upper part of this tissue five or six tortuous vessels ascend obliquely backwards, pierce the tunica albuginea, and arrive at the head of the epididymis; here they increase in size, and become coiled or convoluted; these are the *vasa efferentia* or *coni vasculosi*: they all terminate in the head or globus major of the epididymis, and unite into one small duct (the vas deferens), which is twisted and coiled over and over again in a most extraordinary and peculiar manner. The body and globus minor of the epididymis are solely composed of this convoluted vessel, which by care may be unravelled to a great extent; the convolutions of this tube, of which the epididymis thus consists, are connected to each other by fine cellular tissue and by the reflected tunica vaginalis; the epididymis has no fibrous capsule like the testis; from its lower extremity the *vas deferens* at length escapes, and increasing in size and density, this duct bends upwards along the inner side of the epididymis, and a little above the head of the latter it becomes connected to the spermatic vessels and cremaster muscle; with these it continues its course obliquely upwards and outwards along the inguinal channel, and through the internal abdominal ring: it here separates from the spermatic vessels, the latter ascending towards the spine, while the vas deferens passes backwards, inwards, and downwards, enclosed in the lateral fold of peritonæum, which conducts it to the bladder, along the side and inferior fundus of which it runs internal to the vesicula seminaris, and converging to its fellow; at the base of the prostate gland each vas deferens joins the duct of the corresponding vesicula, and the union of these forms the *ductus ejaculatorius communis*, which runs through the prostate obliquely forwards and inwards, and opens into the prostatic portion of the urethra on the side of the verumontanum. While the vas deferens is contained in the spermatic cord, it lies posterior to the spermatic arteries and veins, and to the cremaster muscle; as it passes through the internal ring it hooks round the epigastric artery, being separated from it by the spermatic artery alone; the vas deferens next passes over the psoas and iliac muscles, the external iliac artery and vein: it then bends over the obliterated hypogastric artery and descends internal to it; and in the same manner it next crosses over the urethra, so as to lie at first anterior to that tube, or between it and the bladder, and then to descend along its internal side; the vas deferens then runs between the bladder and rectum, near to its fellow, and internal to the vesicula seminalis, as far as the prostate gland, which it perforates in the direction before mentioned. This vessel has a peculiar hard wiry feel like whip-cord: its caliber is small; its coats are two in number, an internal mucous, and an external, very thick, firm and white, like cartilage. Between the vesiculæ each vas deferens is flattened, enlarged, and often convoluted: when it enters the prostate it again contracts, and its firm external tunic ceases. In some a second duct will be found to leave the testis and to run for some distance parallel to the vas deferens, which in some cases it will join, while in others it will be found to end in a cul de sac. The *spermatic cord* extends from the epididymis to the internal abdominal ring; it consists of the vas deferens, spermatic artery, veins, and nerves; this fasciculus of vessels is covered by loose cellular membrane, and by the cremaster muscle: beneath the latter the vessels of the cord will be found joined together by a fine but

tolerably dense membrane, named the *tunica vaginalis of the cord;* this membrane is the remains of that portion of peritonæum which in the fœtus accompanied the spermatic vessels of the scrotum, and which after birth lost its serous characters, and became converted into condensed cellular membrane; this covering is strengthened by that prolongation of the fascia transversalis which is continued from the internal abdominal ring along the spermatic vessels.—The spermatic artery arises from the abdominal aorta below the renal artery, and not unfrequently from the latter; it descends along the psoas muscle, passes through the internal abdominal ring on the outer side of the epigastric artery; it then enters the spermatic cord, and is conducted to the back part of the testicle; it divides into several branches which enter the rete testis; these subdivide minutely as they proceed into the substance of the testicle, in which they terminate in the commencement of the tubuli seminiferi and of the spermatic veins. The last named vessels leave the rete testis, twine around the arteries, and then ascend in the spermatic cord; a little above the testicle these vessels become very tortuous, and form a plexus, which is named the Corpus Pampiniforme: the spermatic veins then accompany the spermatic artery through the inguinal canal and along the psoas muscle towards the spine; the spermatic vein on the right side generally ends in the inferior cava near the entrance of the right renal vein; the spermatic vein on the left side frequently ends in the left renal vein. The nerves of the testicle are derived chiefly from the spermatic plexus, which is formed by the union of branches from the lumbar ganglions of the sympathetic, with filaments from the splanchnic nerves and from the renal plexus; the cremaster muscle is also supplied by branches from the lumbar plexus of spinal nerves, hence this muscle is, to a certain extent, voluntary.

The *vesiculæ seminales* are two in number; they are situated on the inferior surface of the bladder behind and above the prostate gland, on the outer side of the vasa deferentia, and anterior to the rectum; each is of an oval figure, about two inches long and half an inch broad; the superior and posterior extremity is round, and in contact with the ureter; the anterior extremity is narrow, connected to the prostate gland, and ends in a small duct which joins the vas deferens; the union of these forming the common seminal or ejaculatory duct, which latter passes obliquely forwards and inwards through the prostate gland, and opens into the urethra by the side of the verumontanum. Although the vesiculæ look like a congeries of cells, yet by dissection they may be unravelled, so as to appear as one continued tube convoluted or coiled very much, the different coils communicating with each other; these organs are covered by a dense fascia, which is continued from that covering the prostate gland. Each vesicula consists of two tunics, viz. mucous membrane internally, and peculiar gray substance externally, somewhat similar to, but softer than the outer coat of the vas deferens. The vas deferens communicates more freely with the corresponding vesicula than the latter does with the former, hence air or fluid injected into the vas deferens will generally distend the vesicula seminalis of the same side before it escapes into the urethra. These organs are generally believed to contribute some additional secretion to the seminal fluid, rather than to serve as reservoirs for the latter; their exact use, however, is not well known; they are wanting in many animals. The *Prostate gland* is situated at the anterior and inferior part of the pelvis, behind the

triangular ligament, in front of the rectum, to which it is connected by cellular membrane; it surrounds the neck of the bladder, and is attached by the anterior ligaments of this organ to the lower edge of the symphysis pubis, from which it is about three-fourths of an inch distant. The prostate gland is somewhat heart-shaped, or triangular; it is also compared to a chesnut; the base or larger extremity is posterior, and connected to vesiculæ seminales; the apex is anterior, and extends within a short distance of the triangular ligament; the neck of the bladder, and about an inch of the urethra, run through its substance, but a small portion of it lies superior to the neck of the bladder and urethra; this part is convex, and is covered by the dorsal veins of the penis, and by the anterior ligaments of the bladder; the inferior or posterior surface of the gland is almost flat, a slight groove is generally observable on it, extending along the mesial line; this surface is attached to the fore-part of the rectum, and may be felt distinctly either in the living or in the dead subject by the finger introduced into the intestine about two inches and a half above the anus; the sides of the gland are smooth and round, and are covered by a strong fascia, by several veins, and by the levatores ani muscles. In the base or posterior end is a notch for the entrance of the common ejaculatory ducts; this notch, together with the groove on the posterior surface, and the passage of the urethra above this, have caused this gland to be described as consisting of two lateral portions, called the *right* and *left lateral lobes*; these are connected to each other posteriorly by a small transverse process, called the *middle lobe*; this may be seen by detaching the vesiculæ seminales, and vasa deferentia from the bladder, and leaving them suspended by their common ducts, the middle lobe of the prostate will then be seen to pass from one lateral lobe to the other, and to be closely connected to the mucous membrane of the bladder.

The prostate gland has a firm resisting feel, is of a greyish color, and appears to possess a very compact structure; this, however, is chiefly owing to the strong fascia which invests it, and which forms its capsule: the capsule has been already described as being partly derived from the posterior layer of the triangular ligament, which expands on the sides and inferior surface of the gland, and partly from the reflection of the pelvic fascia from the pubes, called the anterior ligaments of the bladder. Next continue the incision which was made in the fore part of the bladder, through the upper part of the prostate, so as to lay open the urethra, we shall perceive how this gland surrounds the canal, also the greater thickness of its lateral portions. The prostate glands consist of several follicles or acini closely connected to each other, and covered externally by the capsule, and internally by the mucous membrane; these follicles open by several small ducts, ten or twelve, on the lower surface of the urethra, on either side of the verumontanum; some small ducts also open on the upper surface of the canal.

The *penis* is covered by the common integuments, and by the superficial fascia; the skin is thin and loose; it is continued from that of the abdomen and scrotum around this organ, and extends some way beyond it in the form of a loose fold, the *prepuce;* from the extremity of this process the skin is reflected inwards as far as the corona glandis, where it becomes very thin; it is thence continued over the glans penis to the orifice of the urethra where it is continuous with the lining membrane of the urethra; inferior to this opening

it forms a fold, the frænum preputii; *the prepuce*, therefore, is only a fold of the common integument, the sides of which are connected together by very loose cellular tissue; this fold is expanded when the prepuce is drawn back, or when the penis becomes distended: the inner side of the prepuce is of more delicate texture than the external, and that portion of it which is continued over the glans is still more delicate than either. Beneath the skin, around the corona glandis, are a number of small sebaceous glands, glandulæ odoriferæ or Tysoni. The superficial fascia which covers the penis is continued from that of the abdomen, and extends around the penis as far as the corona glandis; it is thick and strong posteriorly, where it is reflected from the linea alba on the penis, so as to form the superficial suspensory ligament of the latter; anteriorly it is loose and delicate. Beneath these coverings the penis is found to consist of two long cylindrical bodies, termed the crura or corpora cavernosa penis; each of these is composed of a strong, elastic, tendinous, and fibrous substance, forming a sort of tube, which is filled with a soft cellular tissue, through which a considerable artery, and several small tortuous veins, run from one end to the other. Each crus penis commences narrow in front of the tuber ischii, and adheres to the rami of the ischium and pubis, as far forwards as the symphysis; anterior to this the two crura become inseparably united, and continue so as far as the corona glandis; here each crus ends in an obtuse point, over which the glans penis, which is the expanded extremity of the corpus spongiosum urethræ, is folded; the two crura are attached to the symphysis pubis by the *true suspensory ligament*, which is very strong, and of a triangular figure; it arises from the symphysis, and is inserted into each crus; it consists of two laminæ, between which the dorsal vessels and nerves of the penis pass. The crura penis are separated from each other by an imperfect tendinous septum, composed of parallel fibres, with such intervals between them that the cavity of one crus communicates with, and can be injected from that of the other; this septum is named *pectiniforme*. The crura penis are somewhat conical, the apex of each being attached to the ischium and pubis, the base supporting the glans; they are round externally, flattened towards each other; a wide and deep groove exists between them inferiorly, which contains the urethra, and a more superficial one superiorly, in which the dorsal vessels and nerves of the penis run. The erection of the penis during life is caused by a greater quantity of blood than usually circulates through this organ being propelled by an increased action of the arteries into the small vessels of the corpora cavernosa penis: anatomists are not agreed as to the exact structure of the corpora cavernosa, or as to the proximate cause of their erection during life, or how the blood is circumstanced during that condition; some consider that the arteries pour their blood into the cells of the cellular tissue which surrounds them, so as to cause their distension, and that from these the blood is slowly and gradually absorbed by the veins; others conceive that the arteries directly communicate with the veins, and that these latter vessels are tortuous and coiled to such a degree as to retard the course of the return of the blood, and so cause the distension and consequent erection of the whole organ.

The *urethra* extends from the neck of the bladder to the extremity of the penis; it is lined by a fine mucous membrane, which is continuous posteriorly with the mucous membrane of the bladder, and anteriorly with the thin

integument, which is reflected from the inside of the prepuce, over the glans penis, as far as, and even within, the orifice of the urethra. This membrane is covered at first by the prostate gland, and this portion of the canal is called the *prostatic portion* of the urethra; the next succeeding portion is covered by the compressores urethræ muscles, by the triangular ligament, and by a peculiar reddish or spongy looking cellular tissue, which contains several small blood-vessels, chiefly veins; this part of the urethra is called the *membranous portion;* the remainder of the canal is covered by a cellular and vascular substance of a dark red or purple color, named the corpus spongiosum urethræ, which commences in the bulb, and ends in the glans penis; this portion of the urethra is named the *spongy portion.* The first, or the prostatic portion of the urethra is within the pelvis; it is about an inch and a quarter, or an inch and a half in length; in the erect position of the body its direction is downwards and forwards; it is nearer to the upper than to the lower surface of the gland. The membranous portion is about half an inch long; it is described in general as being concave towards the pubes: it is, however, but very slightly so, it runs nearly horizontal, about three quarters of an inch below the symphysis pubes. The spongy portion commences in the bulb in front of the triangular ligament, extends to the extremity of the canal, and ends in the glans penis; this part of the canal is surrounded by a vascular and cellular texture, named the corpus spongiosum urethræ, which has some resemblance to the corpora cavernosa penis. The corpus spongiosum urethræ consists of a number of fine cells, which communicate with each other; through these an artery from each side, (a branch from the internal pudic) extends; these vessels send off numerous branches, which pour their blood into the surrounding cells, from which the veins afterwards absorb it: the bulb and the glans penis are expansions of this cellular texture, the former on the inferior, the latter on the superior part and sides.

This spongy substance is invested by a fine, but strong and semi-transparent aponeurosis very different from that which covers the corpora cavernosa. The corpus spongiosum surrounds the urethra, but is thicker inferiorly and laterally than superiorly; there is no direct communication between the corpus spongiosum urethræ and the corpora cavernosa penis, the one can therefore be distended with air or injection without the other, or both may be injected with different colored fluids. In order to inject the crura penis, make a small opening in each crus near its attachment to the ischium, insert a pipe into one of these, and force warm water through it; this will soon escape through the opening in the opposite crus, carrying along with it the blood which was contained in the cells, then secure with a ligature the opposite crus, and inject some colored fluid. To prepare the corpus spongiosum urethræ, make a small opening in the substance of the bulb, next, open the dorsal vein of the penis, in it secure a small pipe, water injected through this will escape at the opening in the bulb; when all the blood shall have been thus washed out, the latter opening may be secured, and some colored fluid injected along the dorsal vein.

If, however, a fine injection be forced from the pudic, or from the internal iliac artery, it may be made to distend the corpora cavernosa penis, and the corpus spongiosum urethræ at one and the same time. The student may now detach the crura penis and the neck of the bladder from the pubes, and

remove these organs together with the urethra from the subject; continue an incision from the anterior part of the bladder through the upper part of the prostate gland, and of the urethra to its extremity; the mucous lining of the urethra will be thus exposed, the difference in the diameter and other peculiarities in different parts of it may now also be observed. 1st, the prostatic portion is somewhat contracted at either extremity, and dilated in the centre, particularly on the lower surface, and at either side of the middle line; these enlargements are called the *prostatic sinuses;* they are separated from each other by a prominent fold of the lining membrane, extending from the uvula of the bladder along the mesial line of the urethra, as far as the bulb; this fold is named *verumontanum,* or caput gallinaginis; in the centre of it is a very large lacuna (*sinus pocularis*), the orifice of which is directed forwards; on either side of this pouch, and in general external to it, is the opening of the common ejaculatory duct, external to which, and in the prostatic sinus on each side are the several small orifices of the ducts of the prostate gland. 2d, the membranous portion is shorter, and of a smaller caliber than the prostatic; it is cylindrical, its anterior extremity is the narrowest portion of the canal. 3d, the spongy portion of the urethra is much dilated at first, particularly inferiorly (*sinus of the bulb*); anterior to this the small ducts of the anti-prostatic glands open. The canal of the urethra contracts a little beyond the bulb, and continues of nearly the same diameter until it arrives opposite the scrotum; it is there slightly contracted for a short distance: about an inch posterior to the external orifice of the urethra the canal is dilated in the transverse direction; this dilation is called *fossa navicularis:* lastly, the orifice of the urethra is contracted into a narrow vertical slit. Several small lacunæ open on the surface of the mucous membrane of the urethra, between the bulb and the anterior extremity; the orifices of these, in a healthy condition of the membrane, are very small; they are all directed forwards: if bristles be introduced into some of these ducts they will be found in many cases to extend backwards for near an inch in the submucous tissue; these lacunæ secrete a thin mucous fluid, which is expelled by the urine in its passage along the urethra: in chronic diseases of the urethra these ducts not unfrequently become so much enlarged as to admit the end of a small bougie, and so lead to the formation of a false passage: the largest lacunæ are on the upper surface of the urethra; one in particular, near the fossa navicularis, is named the *lacuna magna.**

* During the dissection of the pelvic viscera, perinæum, &c. the student should frequently practice the introduction of a catheter into the bladder, which is to be done in the following manner: the subject lying on its back with the legs drawn up, the penis should be held, by placing the thumb and index finger on each side of the corona glandis, by which means the orifice of the urethra will not be compressed; the penis is then to be drawn upwards, and the catheter, being previously oiled, is now to be introduced in a line with the linea alba into the urethra, directly downward as far as the bulb; the concavity of the instrument being towards the abdomen. The catheter having reached the bulb, its handle is to be depressed by bringing it forwards between the thighs, and in proportion as this is done, the point is elevated, and the catheter glides into the bladder; in this latter part of the operation, the penis must be allowed to sink down, for if it be kept extended on the instrument, the membranous part of the urethra would be drawn towards the pubes, by which means the introduction of the instrument would be rendered difficult.

CHAPTER VII.

§ 1.—*Dissection of the Female Organs of Generation.*

The generative organs in the female are more distinct from the urinary than in the male subject; they may be divided into the external and internal: the *external parts* are the mons veneris, vulva, labia, clitoris, nymphæ, vagina, and perinæum. The *mons veneris* is an eminence placed on the upper and anterior part of the pubes; it consists of a quantity of adipose substance beneath the integuments, which in the adult are covered with hair. The *vulva* is the fissure which extends from the mons veneris to within an inch of the anus. The *perinæum* is the small space in front of the anus. The *labia* are the thick folds of integument which extend one on each side of the vulva, and are united inferiorly in a crescentic edge, called the commissure or fourchette. The *clitoris* is between the superior extremity of the labia; it is a small red projection immediately beneath the symphysis pubis and above the vagina; it is attached by two crura to the rami of the pubes; these unite and form the body of the clitoris, on the anterior extremity of which is a round red swelling called the glans clitoridis; this is covered by a thin loose fold of integument called the prepuce. The clitoris is composed internally of a spongy cellular texture, not very unlike the corpus spongiosum urethræ in the male subject. The *nymphæ*, or labia minora, descend one on each side from the prepuce of the clitoris, and are gradually lost about the centre of the vulva. About half an inch before the clitoris is the round orifice of the meatus urinarius; this opening is surrounded by a fold of mucous membrane. The meatus is from an inch and a half to two inches in length; it leads backwards and upwards along the upper surface of the vagina, and is slightly curved beneath the symphysis pubis. The *vagina* is directly below the urethra; in the child it is partially closed in front by a crescentic fold of membrane, termed the *hymen:* in the adult several reddish eminences surround this opening; the course and connections of this canal will be better seen when the pelvis shall have been divided for the purpose of examining the internal organs of generation. Dissect off the integuments and fascia from the perinæum and labia, and the following muscles may be seen: the sphincter ani, levator ani, and coccygæus; these are similar to the muscles of the same name in the male perinæum, also the transversalis perinæi: the erector clitoridis is analogous to the compressor penis; and the sphincter vaginæ corresponds to the acceleratores urinæ; it extends from the clitoris superiorly around each side of the vagina to the central point of the perinæum in front of the anus. To examine the internal organs of generation make a lateral section of the pelvis in the same manner as was directed in the dissection of the male pelvis. The peritonæum may be first examined; this will be seen to descend along the forepart of the rectum, to within three or four inches of the anus; it is thence reflected forwards on the posterior part of the vagina, the superior third of which it covers; from the vagina it ascends on the posterior surface and sides of the uterus, continues round the superior fundus of this organ to its anterior part, on which it descends as low as the commencement of the vagina; it is thence reflected to the bladder, and is continued over this organ, as in the male subject, to the abdominal muscles; thus, in the female, pelvis the

peritonæum forms one cul de sac between the rectum and vagina, and another between the uterus and bladder. From each side of the uterus a broad fold of peritonæum is extended transversely towards each iliac fossa; these folds are the *broad ligaments* of the uterus; enclosed between the laminæ of each of these are the Fallopian tube, the *round ligament* of the uterus, and the *ovarium* with its ligament and vessels. Dissect off the peritonæum from one side of the rectum and vagina, and the pelvic viscera will be more distinctly seen; the *rectum* takes the same course as in the male, only somewhat more curved. The *vagina* is seen to surround the neck of the uterus, and thence to descend obliquely downwards and forwards between the rectum, the bladder, and urethra; closely connected to the latter, and but loosely to the rectum. The vagina is lined by a vascular membrane, which is covered externally by a dense fibrous tissue and by numerous vessels, particularly veins, which form a plexus (retiform) or spongy body, which is situated beneath the sphincter vaginæ muscle; the vagina is also partially covered by peritonæum on its posterior surface: between the bladder and vagina the *ureter* may be observed; its course is longer and more curved in the female pelvis than in the male. The *uterus* is situated between the bladder and rectum, and connected to both by peritonæum; the broad ligament which is a fold of peritonæum, and the round ligament which is a fasciculus of blood-vessels and nerves bound together by dense cellular tissue, connect each side of this organ to the pelvis, and to the inguinal region. The uterus is somewhat pyriform or triangular, the larger end or fundus being superiorly and posteriorly, the smaller end or cervix inferiorly and anteriorly; the intermediate portion is named the body; the vagina surrounds the cervix uteri, and ascends higher posteriorly than anteriorly; at the lower extremity of the cervix is a small transverse slit, termed the *os uteri* or *os tincæ*. The uterus consists of a dense fibrous substance, covered externally by peritonæum, and lined throughout by mucous membrane, which is continued from the vagina throughout the entire organ, and thence into the Fallopian tubes, along which it extends to their fimbriated extremity, where it becomes continuous with the peritonæum on each side, thus presenting a singular example of the continuity of a mucous and serous membrane with each other; the mucous membrane of the uterus is often of a very dark color, and is marked by several lines. The cavity of the uterus is very small; it is somewhat larger in the superior fundus than elsewhere. The Fallopian tubes are from four to five inches in length; they extend from the fundus uteri upwards and outwards at first, and then a little downwards and backwards; each terminates in a soft fringed extremity, called *Corpus fimbriatum;* these canals are narrow where they join the uterus, but each increases in size near the corpus fimbriatum. The *ovaria* are two small, white, flattened, oval bodies, one on each side, enclosed in the posterior fold of the broad ligament, and behind the Fallopian tube. Each ovary is connected to the side of the uterus by the broad ligament of the latter, also by a round fibrous cord, the proper ligament of the ovary; this is about two inches long, and is enclosed between the laminæ of the broad ligament of the uterus. Each ovary is covered by the peritonæum, which adheres very closely to it; beneath this is a strong white fibrous capsule, within which a number of small vesicles will be found connected together by cellular membrane and vessels

CHAPTER VIII.

DISSECTION OF THE INFERIOR EXTREMITIES.

Each inferior extremity is connected to the trunk by the strong ligaments of the hip joint, and by several muscles which pass from the pelvis to the thigh and leg. This dissection may be performed while the pelvis remains attached to the spine, or the former may be separated from the lumbar vertebræ, and divided into two.

The muscles of the lower extremity are classed into those of the thigh, leg, and foot.

§ 1.—*Dissection of the Muscles of the Thigh.*

Place the extended limb on the back part, raise the integuments from the anterior and lateral parts of the thigh, and from the upper part of the leg; several cutaneous nerves, veins, and lymphatic vessels are met with in this dissection; the nerves are branches of the lumbar plexus, and of the anterior crural nerve; they pierce the fascia lata near Poupart's ligament, and descend chiefly along the anterior and outer side of the thigh. The cutaneous veins are branches of the internal saphena vein; this vessel will be found, in dissecting the leg and foot, to commence at the inner side of the latter, and to ascend along the internal part of the leg and knee to the inner and fore-part of the thigh, along which it continues its course towards the groin; and about an inch and a half below Poupart's ligament it pierces the fascia lata, and joins the femoral vein. In this course the saphena vein receives several cutaneous branches, and, in general, just before it ends in the femoral it is joined by one or two large veins from the outer and fore-part of the thigh, and by some smaller branches from the abdominal parietes; some cutaneous branches from the anterior crural, and lumbar nerves accompany this vein in its course along the thigh. Beneath the integuments the thigh is invested by the superficial fascia, which is prolonged around it from the parietes of the abdomen; in the groin this fascia is thick and laminated, and closely connected to the fascia lata; but inferiorly and posteriorly it is thin and loose, and differs but little from the ordinary sub-cutaneous cellular tissue. This fascia may be easily detached from the fascia lata of the thigh, except in the groin; in attempting to raise it in this region we expose the superficial inguinal glands; these are eight or ten in number; five or six of them are placed parallel to Poupart's ligament, some above, others below it; two or three are situated lower down in the groin than these, near the termination of the saphena vein; these last glands lie on the fascia lata; they are larger than the former, and are parallel to the saphena vein. Through these conglobate inguinal glands the superficial absorbents of the lower extremities pass; also those from the external parts of generation. Beneath the fascia lata, and close to the femoral vessels, are the deep-seated inguinal glands; they are small, and only three or four in number; the deep-seated absorbents of the limb pass through these. The integuments and superficial fascia having been removed, the fascia lata may be next examined. This aponeurosis surrounds the thigh;

it is very strong and tendinous externally, but so thin and weak internally, that without caution it is apt to be removed along with the integuments; it is attached superiorly and externally to the crest of the ilium; posteriorly to the sacrum and coccyx: on the glutæus maximus it is very weak and thin, but at the anterior border of this muscle it becomes very strong, receiving an addition of fibres, both from the tendon of that muscle, and from the tensor vaginæ femoris; anteriorly the fascia lata is attached to Poupart's ligament, and internally to the rami of the ischium and pubis; as this aponeurosis extends down the thigh, it confines the different muscles in their situation, so as to preserve the figure of the limb; several processes also pass in from its internal surface to form sheaths for some muscles, and to bind down others in their place; to many of these processes the muscles adhere, so that when in action they serve to make the fascia more tense and resisting; these processes also serve to increase the surface of origin or attachment of several muscles. Along the posterior part of the thigh the fascia lata is connected to the whole length of the linea aspera, also to the insertion of the glutæus maximus, and to the origin of the short head of the biceps; inferiorly it adheres to the condyles of the femur, surrounds the knee-joint, and receives an addition of fibres from the different tendons in this region; below the knee it is continued over the heads of the tibia and fibula into the fascia of the leg. Numerous foramina are observable in the fascia lata, particularly at the upper and anterior part of the thigh; they transmit cutaneous nerves and vessels: the most remarkable of these holes is that for the saphena vein; it is situated about an inch and a half below Poupart's ligament, and may be most distinctly seen by dividing the vein on the fore-part of the thigh, and raising it towards the abdomen; this opening is semilunar, the concavity directed upwards; from its apparently sharp edge the fascia is reflected backwards, and is lost on the sheath of the femoral vessels. That part of the fascia which is internal to this opening is named the pubic portion of the fascia lata; it covers the pectinæus muscle, adheres to the spine and linea innominata of the pubis, extends behind the femoral vessels, and is continuous with the fascia iliaca; that part of the fascia lata external to the saphenic opening is called the iliac portion; it covers the sartorius, tensor vaginæ, rectus, and iliacus internus muscles, and is continued obliquely in front of the femoral vessels, in the form of a *crescentic* or *falciform process*, the concavity of which is directed downwards and inwards; the convexity is towards the ilium, and attached to Poupart's ligament; the lower cornu of this crescentic process is continuous with the outer cornu of the saphenic opening, and the upper cornu extends in front of the femoral vessels to their inner side, and is inserted along with the third insertion of Poupart's ligament into the linea innominata, or the ilio pectinæa: between the margin of the falciform process and the pubic part of the fascia lata is a thin membrane, perforated by numerous vessels, this is termed the *cribriform fascia;* it is connected on either side to the iliac and pubic portions of the fascia lata, and extends from the saphena vein to Poupart's ligament, in front of the femoral vessels; it adheres to the anterior part of the sheath of the latter, or to the fascia transversalis; when this cribriform fascia is removed, the falciform process is made more distinct. (See Description of Crural Hernia, page 82.) The fascia lata, in some situations, particularly along the outer side of the limb, is seen to consist of two laminæ of fibres; the

external take a circular, the internal a longitudinal direction; these two laminæ are very distinctly separated at the upper and outer part of the thigh by the insertion of the tensor vaginæ femoris; the deep layer, which in this situation is very strong, is attached to the capsular ligament of the hip joint, and to the external head of the rectus muscle. Raise the fascia lata from the anterior and lateral parts of the thigh, several muscles will come into view, the femoral vessels also in the groin will be partially exposed, they are still somewhat concealed by a quantity of adipose substance, and by a few deep-seated lymphatic glands; when these are removed, we always find the vein internal to the artery, and about an inch and a half from the spine of the pubis; immediately external to the vein is the artery resting on the psoas, and about a quarter of an inch external to the artery is the anterior crural nerve, imbedded between the psoas and iliacus, and covered by the fascia iliaca, it does not therefore lie in the sheath of the vessels. Clean the several muscles which now partially appear on the fore-part of the thigh: external to the vessels, the sartorius and tensor vaginæ are first seen; internal to the vessels are the pectinæus, gracilis, and the three adductors, and immediately covering the anterior and lateral part of the femur are the rectus, cruræus, vastus internus, and externus.

MUSCLES ON THE FORE-PART AND SIDES OF THE THIGH.

Tensor vaginæ femoris, at the upper and outer part of the thigh, narrow above, broad and thin below, *arises* tendinous and fleshy from the external part of the anterior superior spinous process of the ilium; it forms a fleshy belly, which descends obliquely backwards, and is *inserted*, broad and thin, into a duplicature of the fascia lata on the outside of the thigh, about three inches below the great trochanter; *use*, to make tense the fascia, to rotate the thigh inwards; also, to assist in flexing and abducting it. The origin of this muscle is between the sartorius and glutæus medius; between these muscles it descends, covered by the fascia lata; its insertion is anterior to that of the glutæus maximus muscle.

Sartorius is the longest muscle in the body, thin and flat like a riband, broader in the middle than at the extremities, situated obliquely along the anterior and inner side of the thigh, *arises* by short tendinous fibres from the anterior superior spine of the ilium, and from the notch below that process, it soon becomes broad and fleshy, extends obliquely across the thigh to its inner side, and descending perpendicularly to the knee passes behind the condyle of the femur; it then turns forwards and outwards towards the inner side of the upper end of the tibia, into which it is *inserted* below the tubercle, by a long flat tendon, the anterior edge of which is attached to the fascia lata covering the knee joint, and the posterior edge sends off an aponeurosis to the fascia of the leg. *Use*, to flex the leg upon the thigh, also the latter on the pelvis; to adduct the thigh and leg obliquely, so as to cross the lower extremities; when the thigh and leg are extended, it assists in raising and advancing forwards the whole limb, also in turning the knee outwards; when the knee is bent, it may turn the leg and toes inwards; in standing, it also supports the pelvis and prevents it bending backwards on the thigh. This muscle through its whole extent is covered only by the fascia lata and the integuments, its

superior extremity lies between the tensor vaginæ and the iliacus internus muscles; its inferior extremity expands into a strong aponeurosis, which covers and adheres to the tendons of the semi-tendinosus and gracilis muscles; in its course along the thigh it first passes over the psoas, iliacus, and rectus muscles, next over the abductor muscles and the femoral vessels, from which it is separated by a strong aponeurosis; inferiorly it passes over the internal lateral ligament of the knee, between the tendons of the abductor magnus and the gracilis. The superior third of this muscle extends in an oblique direction from the ilium downwards and inwards, forms the external boundary of the inguinal region, and lies to the outer side of the femoral vessels; the middle third is more vertical in its course, and is here about two inches broad, and completely covers the femoral vessels, also a part of the adductor, and vastus internus muscles.

Rectus Femoris, long and flat, rather round in the centre, placed vertically on the fore-part of the thigh, *arises* by two tendons, one short, strong, anterior and internal, from the anterior inferior spinous process of the ilium, the other longer, broader, and more curved from the superior and external border of the acetabulum, and from the capsular ligament; these tendons soon uniting form a strong fleshy belly, which descends almost vertically, with a slight inclination inwards; this muscle has a peculiar penniform appearance, it is also tendinous anteriorly in the upper half, so that the sartorius can glide over it, and tendinous posteriorly in the lower half, whereby it can move on the surface of the cruræus. This muscle ends in a flat tendon, which is *inserted* along with the vasti and cruræus into the upper edge of the patella, a few fibres pass anterior to this bone, and are continued into the ligamentum patellæ, which descends obliquely outwards to the tubercle of the tibia. *Use*, to extend the leg on the thigh, and to flex the thigh on the pelvis; it also supports and draws forwards the pelvis on the thigh, and strengthens the capsular ligament of the hip joint. The anterior tendinous origin of this muscle is covered by the sartorius, tensor vaginæ and iliacus internus muscles, the posterior by the glutæus medius and minimus muscles; the remainder of the muscle is only covered by the integuments and fascia; superiorly this muscle lies on the capsular ligament of the hip joint and the external circumflex vessels; in the rest of its course on the cruræus and vasti muscles, to which it is united below, so that some describe these four as one muscle, under the name of *quadriceps extensor cruris*. Beneath the rectus we find this large mass of muscular substance, covering the front and sides of the femur; it may be divided superiorly into three portions, but inferiorly these are inseparably united; the external portion is named vastus externus, the internal, vastus internus, and the middle, cruræus.

Vastus Externus, much larger than the other portions, and larger above than below, *arises* from the root and anterior part of the great trochanter, anterior to the tendon of the glutæus maximus, from the outer edge of the linea aspera, and from the oblique ridge which leads to the external condyle, anterior to the short head of the biceps; from all the external surface of the bone, and from the fascia lata, the fibres descend obliquely forwards; the superior are very long, the inferior are shorter and more transverse, *inserted* into the external surface of the tendon of the rectus, also into the side of the patella, and by an aponeurosis which adheres to the synovial membrane of the

knee-joint, into the head of the tibia. *Use*, to extend the knee, also to rotate the leg outwards; this muscle is partly concealed by the rectus; its external surface is tendinous above and fleshy below, its internal is fleshy above and tendinous below.

Vastus Internus, smaller and shorter than the last, *arises* on the anterior part of the femur, from the inter-trochanteric line; from the inner edge of the linea aspera, its whole length, also from the inner side of the femur, the fibres descend obliquely forwards, and are *inserted* into the inner edge of the tendon of the rectus, also into the patella, and by an aponeurosis, which covers the inner side of the synovial membrane of the knee, into the head of the tibia. *Use*, to extend the knee and turn the leg a little inwards. The vastus internus is partly concealed by the rectus and sartorius, its origin lies anterior to the insertion of the psoas, pectinæus, and adductor muscles, and overlaps the cruræus, so as to be in contact with the vastus externus; its internal surface is tendinous above and fleshy below; an aponeurosis from the two vasti covers the patella and its ligament, also the sides of the joint; this aponeurosis is inserted into the head of the tibia, it serves to support the patella in its situation, and to protect the sides of the articulation like a capsular ligament; a small bursa is situated over the patella, between this aponeurosis and the skin; the insertion of the vastus externus into the patella overlaps that of the vastus internus, and both overlap the cruræus, from which the vastus externus can be more easily separated above, but the vastus internus below.

Cruræus, shorter than either of the vasti, between which it lies, larger and more tendinous below than above, *arises* fleshy from the anterior and external part of the femur, commencing at the inter-trochanteric line, and extending along three-fourths of the bone, as far outwards as the linea aspera; it does not adhere to the inner side of the femur, there being a portion of the latter, nearly an inch in breadth and extending almost the whole length of the bone, to which no muscular fibre adheres; the cruræus descends close to the femur to its inferior third, the fibres then incline forwards, become tendinous posteriorly, and are separated from the bone by a large bursa, and by a considerable quantity of fat; *inserted* into the upper and outer edge of the patella, also into the synovial membrane of the knee behind the vasti, particularly the external, to which it is here intimately united. *Use*, to assist the vasti and the rectus in extending the leg. This muscle is covered by the rectus and the vasti, from the latter it can only be separated superiorly by tearing a few muscular fibres, and tracing some large nerves and vessels that pass between them. The large bursa, which is situated behind the lower part of this muscle, is attached to and frequently communicates with the synovial membrane of the joint; a few muscular fibres are generally attached to this membrane, and have been described as a distinct muscle, the sub-crural or capsular, this *arises* from the anterior surface of the femur, about its inferior fourth, passes forwards and downwards, and is *inserted* into the synovial membrane. *Use*, to raise the synovial membrane in extension of the leg, so as to prevent its being contused by the patella.

Gracilis, flat, long, and thin, broad and fleshy above, round and tendinous below, situated at the inner side of the thigh, immediately beneath the integuments and fascia; *arises* by a thin short tendon from the lower half of the symphysis, and from the inner edge of the descending ramus of the pubis; it

soon becomes fleshy, and descends vertically, one edge directed forwards, the other backwards, and its surfaces looking one inwards, the other outwards; about the inferior fifth of the thigh it ends in a round tendon which passes behind the inner condyle, and then turns forwards along with the tendon of the sartorius, behind and beneath which it lies; *inserted* into the superior part of the internal surface of the tibia, uniting with the sartorius and semi-tendinosus. *Use*, to adduct the leg and thigh, to bend the knee, and turn the leg and foot inwards. The origin of the gracilis is between the triceps and the crus penis; its whole course is superficial, except near the knee, where it is covered by the sartorius; its insertion is inferior to that of the sartorius, and superior to that of the semi-tendinosus; the saphena vein and nerve are situated between its tendon and that of the sartorius at the inner side of the knee, but these are separated from each other by a fascia, which attaches these tendons together, the vein lying superficial: from the tendon of the gracilis an aponeurosis is sent off to the fascia of the leg.

Pectinæus, flat, triangular, broad above, situated at the superior, anterior, and internal part of the thigh; *arises* fleshy from the linea innominata on the horizontal ramus of the pubis, between the spine of that bone and the ilio-pectinæal eminence; it forms a flat fleshy belly, which descends obliquely outwards and backwards, and is *inserted* by a flat tendon into the rough ridge which leads from the lesser trochanter to the linea aspera. *Use*, to adduct and flex the thigh, also, to rotate it outwards; it may also serve to strengthen the capsular ligament of the hip joint internally, and in adduction of the limb to draw the capsule inwards from between the neck of the femur and the acetablulum. The pectinæus lies between the psoas magnus and the adductor longus; the latter overlaps it; it is covered superiorly by the fascia lata, and inferiorly by the femoral vessels; it covers the obturator nerve and vessels, the external obturator muscle, and the adductor brevis; it also adheres to the capsular ligament of the hip joint.

Triceps Adductor Femoris, consists of three portions, which pass in distinct laminæ from the pelvis to the thigh.

Adductor Longus, flat and triangular, broad below, is situated at the upper and internal part of the thigh, superficial to the other adductors and to the pectinæus; it *arises* by a short, small, but strong tendon from the anterior surface of the pubis, between its spine and the symphisis; this ends in a broad fleshy belly, which descends obliquely backwards and outwards, and is *inserted* by a broad thin tendon into the middle third of the linea aspera, between the adductor magnus and the vastus internus, to both of which it is closely united. The origin of this muscle lies between the pectinæus and the gracilis, and above the adductor brevis; its insertion is behind the vastus internus, and in front of the adductor magnus; this adductor is covered by the integuments and fascia superiorly, and by the sartorius and the femoral vessels inferiorly; it lies anterior to the two following muscles.

Adductor Brevis, short, flat, and triangular, is situated posterior to the adductor longus and pectinæus, and internal to the psoas; *arises* flat and tendinous from the anterior inferior surface of the pubis, between the symphisis and the thyroid hole; it soon ends in a fleshy belly, which passes outwards, backwards, and a little downwards, *inserted*, by tendinous slips into the superior third of the internal root of the linea aspera, extending for about

three inches below the lesser trochanter. The origin of this muscle is external to the gracilis, and concealed by the adductor longus and the pectinæus; as it descends it is covered by these muscles, except a small portion near its insertion, which appears between them; this portion is posterior to the femoral and profunda vessels; its insertion is anterior to that of the adductor magnus; in the tendon of this adductor one or two large openings frequently exist for the passage of some of the perforating arteries.

Adductor Magnus, the longest and largest of the adductors, triangular, the base attached to the femur, the apex to the pelvis; *arises* chiefly fleshy from the anterior surface of the descending ramus of the pubis, external to the gracilis, also from the ramus of the ischium, and tendinous from the external border of the tuberosity of the latter; the fibres pass outwards with different degrees of obliquity; those which arise from the pubis ascend obliquely outwards, those from the ramus of the ischium pass outwards and downwards, and those from the tuber ischii more directly downwards; *inserted* fleshy into the rough ridge which leads from the great trochanter to the linea aspera, tendinous and fleshy into the linea aspera, and by a long round tendon into the internal condyle of the femur. The superior edge of this muscle has a twisted appearance, it is nearly parallel to the quadratus femoris; several branches of the internal circumflex vessels pass between these muscles, and in rotation of the leg inwards the lesser trochanter projects between them; the middle portion, which is inserted into the linea aspera, is internal to the insertion of the glutæus maximus, and to the origin of the short head of the biceps. This part of the muscle is perforated by several branches of the perforating arteries; at the lower part of the linea aspera this muscle appears to separate into two portions, one of which is inserted into the linea aspera, between the vastus internus and the short head of the biceps; the other is continued into the long tendon which is inserted into the inner condyle. The adductor magnus is covered internally by the gracilis, and anteriorly by the long and short adductors, the pectinæus, part of the sartorius, and the femoral vessels; posterior to it are the sciatic nerve, and the hamstring muscles; the tendinous insertion of the lower part of this muscle is intimately connected to the vastus internus: about the inferior fourth of the thigh there is a large oblique opening between these two muscles, through which the femoral vessels pass into the poplitæal space. *Use*, the three adductors, in addition to adducting the limb, can rotate it outwards; they also serve to steady and support the pelvis on the thigh; the long and short adductors can also flex the thigh on the pelvis, and the adductor magnus can extend it.

In dissecting the preceding muscles, we observe the following vessels and nerves.

The *Femoral Artery* passes from under Poupart's ligament about midway between the symphisis pubis and the spine of the ilium; it thence descends obliquely inwards and backwards, and about the lower part of the middle third of the thigh it perforates the tendon of the adductor magnus, enters the poplitæal space, and then receives the name of poplitæal artery. In the upper third of the thigh, or in the inguinal region, the artery is covered only by the skin, superficial fascia, some lymphatic glands, and the fascia lata; in the middle third of the thigh it receives the additional covering of the sartorius, and beneath this a very strong tendinous aponeurosis, which passes

from the tendons of the adductor longus and magnus over the artery and vein, and joins the tendon of the vastus internus; in this part of the thigh the artery is enclosed in a perfect tendinous sheath, consisting anteriorly of the aponeurosis just mentioned, posteriorly and internally of the tendons of the adductors, and externally of the vastus internus: at the lower end of the sheath the artery passes into the ham through a large oval opening which is bounded superiorly by the adductor longus and magnus, externally by the vastus internus, internally by the adductor magnus, and inferiorly by the united tendons of the adductor magnus and vastus internus. The femoral artery in this course first passes over a few fibres of the psoas, next over the pectinæus and adductor brevis, the adductor longus, and a small portion of the magnus.

The femoral artery, immediately below Poupart's ligament, gives off, 1st, some cutaneous branches; 2d, small arteries to the inguinal glands; 3d, about two inches below Poupart's ligament, a very large branch, the profunda; 4th, several muscular branches to the sartorius and vastus internus; and 5th, just before it enters the ham the anastomotica magna which is distributed to the muscle and integuments at the inner side of the knee. The *profunda* is the largest branch of the femoral; it descends behind that vessel and to its inner side, and gives several branches to the muscles of the thigh, namely, the external and internal circumflex, and the three or four perforating arteries. (See Anatomy of the Vascular System.) The *femoral vein* takes the same course as the artery; in the groin it always lies to its internal or pubic side, but as it descends it becomes posterior to it. In dissecting the muscles on the fore-part of the thigh, numerous branches of the *anterior crural nerve* are met with; this nerve in the groin is separated into several branches, many of these become cutaneous, others pass to the muscles on the fore-part of the thigh, and two or three accompany the femoral artery; one of these, the *nervus saphenus*, enters its tendinous sheath, and descending along the fore-part of the artery, as far as the opening in the tendon of the triceps, then leaves that vessel, descends between the tendons of the sartorius and gracilis muscles to the inner side of the knee; it there becomes cutaneous, and attaching itself to the saphena vein, it accompanies this vessel along the inner side of the leg to the internal ankle. (See Anatomy of the Nervous System.)

§ 2.—*Dissection of the Posterior Part of the Thigh.*

Place the detached extremity on its fore-part, with a block beneath the hip joint, so as to flex the latter slightly, and thus extend the muscles in this region. Raise the integuments from the posterior surface of the limb, from the crest of the ilium to the calf of the leg; the cutaneous nerves which are met with in this dissection, are branches from the lumbar nerves, from the sacral plexus, and from the sciatic nerve. The cutaneous veins pass in different directions, some turn round the inner side of the limb to the saphena vein, others penetrate between the muscles and join the deep veins which accompany the muscular or the perforating arteries, and others descend to the popliteal space, and join the popliteal or the lesser saphena vein. The fascia lata over the glutæus maximus is weak, but anterior to that muscle, that is,

covering the glutæus medius, it is very strong, and adheres to the surface of this muscle, and to the crest of the ilium above it; on the posterior part of the thigh, the fascia is not so dense as on the outer or anterior part; inferiorly, over the popliteal region, or the ham, it is much stronger than above; from the thigh it is continued over the muscles of the leg, in which situation it may be examined afterwards: the fascia and integuments being removed, the muscles should be cleanly dissected; these may be divided into the muscles of the hip and of the thigh.

DISSECTION OF THE MUSCLES OF THE HIP.

These are, the three glutæi, the pyriformis, the gemini, the two obturator, and the quadratus femoris.

Glutæus Maximus covers the greater part of the pelvis, also the upper part of the thigh; it is somewhat square, one edge being attached to the sacrum, the opposite edge to the femur, and to the fascia lata, the other edges are directed one upwards and forwards, the other downwards and backwards. The inferior edge is thick and round, and covered by a great quantity of fat; this forms the *fold of the nates*. It is difficult to clean the surface of the glutæus maximus, its fasciculi are so coarse and rough, this may be facilitated by dissecting parallel to the fibres, that is, in a line drawn from the sacrum towards the great trochanter. This muscle *arises* by fleshy and short aponeurotic fibres, from the posterior fifth of the crest of the ilium, from the rough surface between the crest and the superior semicircular ridge on this bone, from the posterior ilio-sacral ligaments and lumbar fascia, from the tubercles on the posterior surface of the sacrum, the side of the coccyx, and from the great sciatic ligament, which last it covers; the fibres are collected into distinct fasciculi, which descend obliquely outwards and forwards, nearly parallel to each other, converging a little towards the thigh; the lower fibres are the longest, they all form a strong and dense mass, particularly below, and end in a flat and thick tendon, whose external surface is rough and coarse, but the internal smooth, and lined by a bursa which separates it from and allows it to glide over the great trochanter; this tendon is *inserted* into a rough edge which leads from the trochanter to the linea aspera, also into the upper third of that line, and by a tendinous expansion into the fascia lata, covering the vastus externus muscle. *Use*, to extend the thigh, also to abduct and rotate it outwards, to support the pelvis and the trunk on the lower extremity, also to make tense the fascia lumborum and the fascia lata. The glutæus maximus is covered by the integuments, by a considerable depth of fat, and by a thin fascia; as the latter approaches the upper edge of the muscle, it becomes more strong and adherent, and is thence extended over the anterior part of the glutæus medius, to which it adheres very closely, and is then inserted into the crest and anterior spine the ilium. The glutæus maximus covers all the muscles on the posterior part of the pelvis, except the anterior portion of the glutæus medius, which is covered by the fascia just now mentioned; its insertion into the linea aspera is above the short head of the biceps, and between the vastus externus and adductor magnus; a very large bursa lines its tendon, and is expanded over the trochanter and a portion of the vastus externus; it is very thin, it usually contains much synovial fluid, and it is frequently

intersected by tendinous bands: a smaller bursa is often situated below it, between the tendons of the glutæus maximus and vastus externus.

Divide this muscle by a perpendicular incision, and separate the edges; several muscles, vessels, &c. may be noticed, having the following relation to each other: commencing above, we see the glutæus medius muscle, beneath this, the pyriformis, and between these, the glutæal vessels and the superior glutæal nerve; below the pyriform muscle we remark the great sciatic and some smaller nerves, also the sciatic and pudic vessels, all escaping from the pelvis by the lower part of the sciatic notch; next in order are the gemini muscles surrounding the tendon of the obturator internus, below these is the quadratus femoris, parallel to the superior fibres of the adductor magnus; the great sciatic ligament, the tuber ischii, and the superior attachment of the hamstring muscles are seen in this dissection, also several small arteries and veins, and a considerable quantity of loose watery cellular tissue, which surrounds the sciatic nerve in its course through the depression between the trochanter and tuber ischii.

Glutæus Medius, triangular, flat, thinner than the last described muscle is exposed by dividing the glutæus maximus and dissecting off the strong fascia which extends from its anterior edge to the crest of the ilium, *arises* by fleshy and aponeurotic fibres from the deep surface of this fascia, from the three anterior fourths of the crest of the ilium, from the superior semicircular line or ridge which leads from the anterior spinous process of the ilium to the upper part of the sciatic notch, and from the surface of the ilium, above and below that ridge; the fibres descend in different directions, the middle perpendicularly, the anterior, which are very short, and the posterior, which are long, obliquely; they all converge into a strong and broad tendon, which is *inserted* into the upper and outer part of the great trochanter, and is attached anteriorly to the tendon of the glutæus minimus. *Use*, to abduct the thigh; its posterior fibres can extend and rotate it outwards, its anterior fibres can flex and rotate it inwards; it also serves to maintain the pelvis in equilibrio on the femur, as when standing on one leg. This muscle is covered in part by the glutæus maximus; the anterior and larger portion is covered only by the integuments and fascia lata; it lies on the glutæus minimus, its posterior edge is parallel to the pyriform muscle, and separated from it by the glutæal vessels and nerves; the anterior edge is nearly parallel to the tensor vaginæ muscle, is united to it above, but separated from it below by a quantity of fat, and by several branches of the external circumflex vessels and nerves.

Glutæus Minimus, is exposed by detaching from its origin the glutæus medius; small, semicircular, more tendinous than the last, it *arises* from the inferior semicircular ridge on the dorsum of the ilium, and from the rough surface between it and the edge of the acetabulum; the fibres converge as they descend, and end in a strong round twisted tendon, which is *inserted* into the upper and anterior part of the great trochanter, first passing over a small bursa. *Use*, similar to the last, it also strengthens the ilio-femoral articulation, and as it adheres to the capsular ligament, it can draw this out of the joint in abduction of the thigh. This muscle is covered by the glutæus medius, and a little overlapped by the tendon of the pyriformis, it covers the capsular ligament and the external tendon of the rectus.

Pyriformis, is of a flattened triangular form, the base at the sacrum within the pelvis, the apex at the trochanter; situated partly within the pelvis, partly

behind the hip joint, nearly parallel to the posterior border of the glutæus minimus; it *arises* by three tendinous and fleshy fasciculi, from the anterior or concave surface of the 2d, 3d, and 4th divisions of the sacrum; it also receives a few fibres from the anterior surface of the great sciatic ligament, and from the upper and back part of the ilium; the fibres form a thick fleshy belly, which passing through the great sciatic notch, descends obliquely outwards and a little forwards, and is *inserted* by a round tendon into the upper part of the digital fossa, at the root of the great trochanter above the tendons of the gemini and obturator muscles, to which it is connected. *Use*, to abduct the thigh, to extend and rotate it outwards, it can also act on the capsular ligament in the same manner as the glutæus minimus. Within the pelvis this muscle lies on the sacrum and is covered by the hypogastric vessels, the sciatic plexus of nerves, and the rectum; the sciatic nerve often perforates it, near its lower margin; on the dorsum of the pelvis this muscle is covered by the glutæus maximus, and is parallel to, but not covered by the glutæus medius; it adheres to the capsular ligament, and is superior to the gemini, from which it is separated by the sciatic nerve and vessels: this muscle divides the sciatic notch into two parts, through the superior pass the glutæal vessels and nerves, through the inferior the sciatic and pudic vessels, the sciatic nerve and several smaller branches of the sacral plexus of nerves. To expose the following five small rotator muscles of the hip joint, draw to either side the great sciatic nerve, and remove the surrounding loose cellular tissue.

Gemelli, two small muscles behind the ilio-femoral articulation between the ischium and the trochanter, the superior *arises* narrow and fleshy from the spine of the ischium; the fibres pass outwards above the tendon of the obturator internus, and are *inserted* with it into the upper part of the digital fossa of the great trochanter. Inferior *arises* also fleshy from the upper part of the tuber ischii, and from the great sciatic ligament, the fibres run parallel to the former, and are also *inserted* into the digital fossa. *Use*, to rotate the thigh outwards, also to abduct it, to strengthen the capsular ligament and to confine the obturator tendon in its situation. These muscles are concealed by the glutæus maximus and the sciatic nerve; they are placed between the pyriformis and the quadratus femoris muscles: they form a sort of sheath around the tendon of the obturator internus, and adhere to its edges; they appear as portions of this muscle added to it as it escapes from the pelvis; the inferior is the larger of the two; the superior is inserted between the pyriformis and the obturator internus, and the inferior between the tendons of the obturator internus and externus: they both adhere to the capsular ligament.

Obturator Internus, is situated partly within the pelvis and partly behind the ilio-femoral articulation; somewhat triangular, the base within the pelvis, the apex at the great trochanter, *arises* by aponeurotic and fleshy fibres within the pelvis from the superior or pelvic surface of the obturator or thyroid ligament, and from all the circumference of the foramen of that name, except at the upper part where the obturator nerve and vessels pass through; beneath these a ligamentous arch is extended, and from this some fibres of this muscle proceed; it also arises from the pubis internally, and from the ischium inferiorly, and from a thin but strong fascia of the same name, which covers this muscle and separates it from the levator ani muscle; the fibres descend obliquely outwards and backwards, converging towards the lesser sciatic

notch, which is between the spine and the tuberosity of the ischium; the fibres here end in a flat tendon, which turning outwards, winds round the cartilaginous pulley-like surface which the ischium here presents, a loose bursa, and one, in general, containing a quantity of synovia, is here interposed between this tendon and the bone; the tendon now runs outwards on the dorsum of the pelvis, between the gemini muscles, and is *inserted* into the digital fossa of the great trochanter. *Use*, to abduct and rotate the thigh outwards; it may also act on the capsular ligament. This muscle within the pelvis is covered by the peritonæum, the pelvic fascia, levator ani muscle, and by a strong aponeurosis, termed the obturator fascia, which serves to give origin to some fibres both of the obturator muscle and of the levator ani, between which it is interposed; the *obturator fascia* is the external layer of the pelvic fascia; it adheres superiorly to the ilium and pubis, and is inserted inferiorly into the great sciatic ligament, into the tuberosity and ramus of the ischium, also into the ramus of the pubis, it here becomes continuous with the triangular ligament of the urethra; this fascia is closely connected to the obturator internus muscle, except inferiorly where the internal pudic nerve and vessels intervene. As the obturator tendon is passing through the sciatic notch, its deep surface is divided into four or five distinct tendons, which are lined by the synovial membrane, and connected to each other like so many plaits or folds; the pudic vessels lie external to this tendon in this situation; the continuation of the tendon to its insertion has the same relations as the gemini muscles.

Quadratus Femoris, *arises* by fleshy and aponeurotic fibres from the external surface of the tuber ischii, anterior to the tendon of the semi-membranosus, the fibres pass transversely outwards, and are *inserted* tendinous and fleshy into the inferior and posterior part of the great trochanter, and into the posterior inter-trochanteric line. *Use*, to adduct and rotate the thigh outwards: this muscle is covered by the glutæus maximus and sciatic nerve; its origin is also concealed by the hamstrings; it is parallel to and between the gemini and the adductor magnus; its lower border is overlapped by the latter; it covers the obturator externus, the lesser trochanter, and the insertion of the psoas and the iliacus. Divide this muscle, and a little dissection will expose the following, particularly if the gracilis, adductor, and pectinæus muscles have been previously removed.

Obturator Externus, situated at the superior, posterior, and internal part of the thigh, somewhat triangular or pyramidal, the base towards the pubes, the apex at the trochanter, *arises* fleshy from the inferior surface of the thyroid or obturator ligament, and from the surrounding surface of the pubis and ischium, the fibres descend obliquely outwards and backwards behind the neck of the femur, in a sort of notch or groove between the tuber ischii and the edge of the acetabulum; here they end in a strong tendon, which ascends a little behind the neck of the femur, then runs directly outwards along the inferior gemellus, and adhering to the capsular ligament, is *inserted* into the lower part of the digital fossa. *Use*, to adduct the thigh, and to rotate it outwards; it also supports and strengthens the inferior and posterior part of the ilio-femoral articulation, particularly in abduction of the thigh. This muscle is placed in a very deep situation, being covered, anteriorly, by the adductor brevis and pectinæus, also by the obturator nerve and vessels, internally by

the adductor muscles, externally by the joint, and posteriorly by the quadratus femoris and glutæus maximus.

The several small muscles just described, in addition to their individual actions, effect the common purpose of strengthening the ilio-femoral articulation; the capsular ligament of this joint is covered anteriorly by the rectus, psoas, and iliacus; internally by the pectinæus and obturator externus; externally by the tendon of the rectus, the glutæus minimus and medius, and posteriorly by the pyriform, gemini, obturator tendons, quadratus femoris, and glutæus maximus; many of these muscles, like the small capsular muscles of the shoulder joint, guard against dislocation in the different motions of the limb, and also serve to protect the capsular ligament by drawing it out of the angle which is formed between the acetabulum and the neck of the femur in the rotatory motions of the limb.

In dissecting the foregoing muscles, several vessels and nerves must have been remarked; the former are derived from the hypogastric or internal iliac vessels; the latter from the sacral plexus of nerves; the arteries are the glutæal, sciatic, and pudic. The *glutæal* artery escapes through the upper part of the sciatic notch, above the pyriform muscle, and immediately divides into several branches; these are distributed to the three glutæi muscles. The *sciatic artery* passes out of the pelvis through the lower part of the great sciatic notch, below the pyriformis; its principal branches descend between the tuber ischii and the great trochanter, and are lost in the surrounding muscles. The *pudic artery* escapes from the pelvis along with the last described vessel; it soon, however, re-enters the cavity through the lesser sciatic notch, and pursues its course forwards and inwards towards the perinæum and pubis, lying at first on the internal surface of the obturator internus, and afterwards on the rami of the ischium and pubis, its branches are distributed to the external organs of generation, and to the muscles in the perinæum. (See Anatomy of the Vascular System.) Each of these arteries have their corresponding veins, which take a similar course, and terminate in the internal iliac vein. The nerves which are found in this situation are the superior and inferior glutæal, the posterior cutaneous, the pudic, the great and lesser sciatic; these are all branches of the sacral plexus. The *superior glutæal nerve* accompanies the glutæal artery, and is distributed principally to the glutæus medius and minimus muscles. The *inferior glutæal nerve* escapes below the pyriform muscle, and is distributed principally to the glutæus maximus. The *inferior* or *lesser sciatic nerve* accompanies the last through the sciatic notch, descends obliquely inwards round the tuber ischii, and is distributed to the surrounding muscles and integuments. The *posterior cutaneous nerve* also passes through the lower part of the great sciatic notch, descends beneath the glutæus maximus, and then becoming cutaneous, divides into several long branches, which may be traced along the posterior surface of the thigh, even to the leg, where in general they will be found to communicate with the posterior cutaneous nerves of that region. The *pudic nerves* take the same course as the pudic artery, and terminate in corresponding branches. The *great sciatic* or *posterior crural nerve*, is the largest nerve in the body; it passes out of the pelvis below, but often through the pyriform muscle, descends behind the hip joint in the fossa between the trochanter and tuber ischii, covered by the glutæus maximus, and passing over the gemini, obturator, and

quadratus muscles; its course along the back of the thigh, and its branches, shall be considered after the dissection of the following muscles

DISSECTION OF THE MUSCLES ON THE BACK PART OF THE THIGH.

The fascia in this situation has been already noticed; the muscles are only three in number, and are commonly called hamstrings; the semi-tendinosus and semi-membranosus form the inner, the biceps the outer hamstring.

Biceps Flexor Cruris, consists of a long and short head; the long head *arises* from the outer and back part of the tuber ischii in common with the semi-tendinosus, this descends obliquely outwards, and soon ends in a thick fleshy belly; about the inferior third of the thigh it joins, at an acute angle, the short head, which *arises* fleshy from the linea aspera, between the vastus externus and the adductors, commencing below the insertion of the glutæus maximus, and continuing to within two inches of the external condyle; here the muscle ends in a strong tendon, which descends at first behind the knee, then turns forwards and outwards towards the head of the fibula, into which it is *inserted;* the tendon is here divided in general by the external lateral ligament into two fasciculi, the superficial of which, in addition to its attachment to the head of the fibula, is also inserted into the fascia of the leg; and the deep fasciculus which is also inserted into the fibula, sends some fibres to the head of the tibia. *Use,* to flex the knee joint, also, by its long head, to extend the thigh and rotate the whole limb outwards; the long head, can also fix the pelvis, and prevent it and the trunk from bending forwards on the head of the femur. The superior fifth of this muscle is concealed by the glutæus maximus, the remainder is covered by the integuments and fascia and descends between the vastus externus and semi-tendinosus, forming the outer hamstring; the long head passes over the semi-membranosus, the sciatic nerve, and the triceps muscles; it also conceals the short head; inferiorly the biceps pass over the external articular vessels and the external head of the gastrocnemius muscle, and forms the outer hamstring.

Semi-tendinosus, large, flat, and fleshy above, round and tendinous below, *arises* by fleshy fibres from the tuberosity of the ischium in common with the long head of the biceps, also from the tendon of the latter for about three inches; it descends obliquely inwards, and about four inches above the knee it ends in a long round tendon, which passing behind the head of the tibia, is then reflected forwards between the tendon of the semi-membranosus and the internal head of the gastrocnemius, and is *inserted* into the anterior angle of the tibia below its tubercle, inferior and posterior to the tendons of the gracilis and sartorious, to which it is connected; from the convex edge of the tendon an aponeurosis is given off, which joins the fascia of the leg. *Use,* to flex the knee and rotate the leg inwards, to extend the thigh, to support the pelvis, and prevent the trunk falling forwards. This muscle is covered superiorly by the glutæus maximus; the rest of its course is superficial, a traverse line usually intersects it about its centre.

Semi-membranosus, beneath the semi-tendinosus, flat and aponeurotic superiorly, thick and fleshy in the middle, round and tendinous below; *arises* by a flat tendon from the upper and outer part of the tuber ischii; this descends obliquely inwards, and ends in a fleshy belly, which retains this muscular

structure lower down than either of the former muscles, a little above the knee it ends in a round tendon, which passes behind the internal condyle, and divides into three processes, one of which passes outwards, another downwards, and a third forwards; the first is a broad aponeurosis, which ascends obliquely outwards, beneath the heads of the gastrocnemius muscle over the back part of the knee-joint, and is *inserted* into the external condyle of the femur; this aponeurosis has been termed the *posterior ligament* of the knee-joint, or the *ligament of Winslow*; the second is a strong and broad fascia, which decends over the poplitæus muscle, and is *inserted* into the posterior part of the heads of the tibia and fibula, and is also continuous with the deep fascia of the leg; the third process appears the continuation of the tendon, it turns forwards beneath the internal, lateral ligament, round the head of the tibia into which it is *inserted*. *Use*, to extend the thigh on the pelvis, and to support the latter on the thigh, to flex the knee and rotate the leg inwards; it also strenghtens the back part of the knee, and can draw the synovial membrane out of the angle of the joint. This muscle, at its origin, lies external to the other hamstrings; it is covered at first by semi-tendinosus, biceps, and glutæus maximus, inferiorly it is superficial; above it passes over the quadratus femoris and adductor magnus muscles; below it overlaps the popliteal vessels, and the internal head of the gastrocnemius, from which last it is separated by a bursa; the sciatic nerve is on its outer, the gracilis on its inner side.

The arteries which are met with in the dissection of these muscles are branches of the sciatic, circumflex, perforating and articular, the numerous ramifications of these vessels are distributed to the hamstring and adductor muscles, and are accompanied by their corresponding veins; the principal nerve in this situation is the *great sciatic*; from the back part of the hip joint this large nerve decends along the back of the thigh to the upper part of the popliteal space, where it divides into the peronæal and posterior tibial nerves: in this course it is covered at first by the glutæus maximus, afterwards by the biceps and semi-tendinosus, and inferiorly by the integuments and fascia; having passed over the quadratus femoris and the other small muscles at the back of the hip joint, it next lies on the adductor magnus, and inferiorly on a quantity of adipose substance. The sciatic nerve gives off several cutaneous and muscular filaments in addition to its two terminating branches, the peronæal and the posterior tibial; the *peronæal nerve* takes the course of the biceps tendon towards the head of the fibula, where it divides into several branches which are distributed to the integuments and muscles on the outer and forepart of the leg, as will be described in the dissection of that region. The *posterior tibial nerve* accompanies the popliteal vessels through the space of that name, which space the student should next examine.

The *popliteal space* is situated behind the knee-joint, extending upwards for about one-fourth of the thigh, and downwards for about one-sixth of the leg; it is somewhat oval, is bounded internally by the inner hamstring, and the internal head of the gastrocnemius; externally by the biceps, external head of the gastrocnemius, and the plantaris; it is covered by the integuments and by a strong fascia, which, derived from the fascia lata, is strengthened by adhering to the condyles of the femur, and to the adjoining tendons; this fascia serves to approximate the side of this region, and thus to give to it a considerable depth. The popliteal space is bounded before by the flat surface of the femur,

by the back part of the joint covered by the ligament of Winslow, by the head of the tibia, and by the poplitæus muscle; in this region are contained the terminating branches of the sciatic nerve, the popliteal artery and vein with their branches; also some lymphatic glands and much adipose substance. The nerves are superficial and external to the vessels, that is, nearer to the biceps; the vessels are close to the bone, and near to the semi-membranosus muscle, the vein being superficial and a little to the outer side of the artery; two or three lymphatic glands are connected to the latter; and a quantity of fat, which is of a peculiar soft consistence, intervenes between the nerve and vessels. The course of the peronæal nerve and vessels. The course of the peronæal nerve has been already noticed; the *posterior tibial nerve* descends nearly vertically between the heads of the gastrocnemius, runs beneath the solæus, and over the poplitæus, and then accompanies the posterior tibial vessels down the leg, and along the inner side of the heel to the sole of the foot, in which course it shall be examined afterwards; in the ham this nerve sends off muscular branches, also the *posterior* or *external saphenus nerve*, which accompanies the posterior saphena vein along the back of the leg, towards the outer ankle, behind which it passes to the external and superior part of the foot, where it is distributed; this nerve is by some called "communicans tibialis." The *popliteal artery* descends obliquely outwards through this space, and at the lower edge of the poplitæus muscle divides into the anterior and posterior tibial arteries; in this course it sends off many muscular and five articular branches, the latter supply the ends of the bones, and the synovial membrane of the knee joint. The *popliteal vein* accompanies the artery, lying superficial and somewhat external to it; it receives branches which correspond to those of the artery; and it is joined inferiorly by the lesser or posterior saphena vein. Next proceed to the dissection of the leg.

§ 3.—*Dissection of the Leg.*

Remove the integuments of the leg and foot; on the plantar surface of the latter they are always remarkably hard and thick, even in the fœtus, particularly beneath the heel and the first and last joints of the toes; in these situations also the subcutaneous fat has a peculiar granulated structure, being intersected by tendinous bands, which pass from the skin to the plantar fascia. Beneath the integuments of the leg we find two cutaneous veins, the internal and external saphena; the *internal saphena* is large and regular, and has numerous branches; it commences by small veins from the upper surface of the toes, and from the dorsum of the foot; these run towards the inner malleolus and unite in one large vessel, which ascends along the inner side of the leg, receiving in its course numerous branches from the integuments; it then passes behind the inner condyle of the femur, and ascending along the inner and anterior part of the thigh, it terminates in the femoral vein about an inch and a half below Poupart's ligament; on the thigh this vein is accompanied by small nerves, which are derived from the lumbar plexus and from the anterior crural; along the leg the saphenus nerve, a branch of the anterior crural, is attached to it, and winds round it. The *posterior* or *external saphena vein* commences behind the external ankle from the junction of several small veins from the integuments of the heel and sole of the foot; it

ascends along the surface of the gastrocnemius muscle, accompanied by the communicans tibialis nerve; at the ham this vein in general joins the popliteal vein, but sometimes it here turns inwards and joins the internal saphena vein, with which it always communicates in its course along the leg. Several cutaneous nerves are distributed to the leg, namely, the internal saphenus, from the posterior tibial, and several cutaneous branches from the peronæal and anterior tibial nerves perforate the fascia of the leg on its outer and anterior part, and are distributed to the integuments of the leg and foot.

The *fascia* of the leg is derived partly from that of the thigh; it also receives additional fibres from the tendons around the knee joint, namely, the rectus and vasti anteriorly; the vastus externus and biceps externally; the sartorius, gracilis, and inner hamstring internally; the fascia adheres to the head of the tibia and fibula, to the spine of the tibia, near its whole length, to the annular ligaments of the ankle joint, and to the malleoli; it can scarcely be said to exist on the anterior surface of the tibia, which is only covered by the skin and periosteum. The fascia of the leg is stronger superiorly than inferiorly; near the ankle it again increases in strength from its connection to the malleoli and to the annular ligaments; these are two in number, the anterior and internal. The *anterior annular ligament* is a little above the joint; it is somewhat square, and stronger externally than internally; in the latter situation it is attached to the malleolar process of the tibia, and to the os naviculare; in the former to the external malleolus, and to the upper part of the os calcis; it consists of two layers, which, by separating and re-uniting, form three rings or sheaths for the tibialis anticus, and the two extensor tendons; the anterior tibial vessels and nerves also pass beneath it. The *internal annular ligament* is broader than the anterior; it is attached to the internal malleolus, and to the os calcis; it forms a sort of arch over the groove or canal in which the three flexor tendons, and the plantar nerves and vessels run. The fascia of the leg is thin posteriorly: near the heel it is indistinct; on either side it is connected to the sheaths of the tendons that pass round the malleoli; and on each side of the tendo Achillis it sends in a lamina to join the fascia which covers the deep muscles of the leg. The fascia serves to confine the muscles in their situation, and to give origin to many of their fibres; this last effect is further accomplished by inter-muscular bands or septa, which pass in from the fascia, between the extensor and peronæi muscles, and and are attached to the tibia and fibula and inter-osseous ligament. From the anterior annular ligament, a thin fascia is extended over the dorsum of the foot: that covering the sole of the foot, the *plantar fascia* is remarkably strong; it *arises* from the extremity of the os calcis, narrow but thick and strong; it passes forwards, expands and divides into three parts, which lie on different planes, and which, by sending in two processes, serve to separate the plantar muscles into three orders, the internal, middle, and external; the lateral portions of this fascia are attached to the sides of the tarsus and metatarsus; the internal portion is the weakest; the middle division is the strongest, and on a plane inferior to the internal; as this middle portion expands beneath the plantar muscles, it is strengthened by transverse fibres, and near the base of the toes it divides into five fasciculi, these diverge, and opposite the head of each metatarsal bone, they each sub-divide into two fasciculi; these pass along the sides of the metatarso-phalangal articulations,

and are *inserted* into the lateral ligaments of these joints, and into the sheaths of the flexor tendons; between these fasciculi the tendons pass, also the digital vessels and nerves of each toe; the plantar fascia possesses the same strength as ligamentous structure; *use,* it serves to retain the arched form of the foot, and to protect the plantar muscles, vessels, and nerves, from pressure; it also gives attachment to several muscular fibres. The muscles of the leg may be divided into those on the anterior, external, and posterior part.

DISSECTION OF THE MUSCLES ON THE ANTERIOR AND EXTERNAL PART OF THE LEG.

The muscles on the fore-part of the leg are the tibialis anticus, extensor pollicis, extensor communis, and peronæus tertius; the muscles on the outer side of the leg are the peronæus longus and brevis: almost all these muscles are connected to each other superiorly, so that they cannot be perfectly separated from each other; they all adhere to and partly arise from the fascia of the leg, therefore, when exposed, they present a rough surface superiorly.

Tibialis Anticus, is next the tibia, somewhat triangular, large and fleshy above, tendinous below, *arises* tendinous and fleshy from the outer part of the two superior thirds of the tibia, from the head of the fibula, from the inner half of the inter-osseous ligament, from the fascia of the leg, and from the inter-muscular septa; the fibres descend obliquely inwards, end in a strong and flat tendon which crosses from the outer to the fore-part of the tibia, runs through a distinct ring in the annular ligament, near the internal malleolus, passes forwards and inwards above the astragalus and naviculare, increases in breadth, and is *inserted* into the inner side of the great cuneiform bone, also, by a tendinous slip into the base of the first metatarsal bone. *Use,* to flex the ankle, to adduct the foot, and to raise its inner edge from the ground; to turn the toes inwards, also to support the leg when standing, and prevent it bending backwards. This muscle is superficial through its whole length; the tendon, at its insertion, is partly concealed by the abductor and flexor pollicis brevis: superiorly this muscle is external to the tibia; inferiorly it is anterior to it: the extensor communis, and extensor pollicis, the anterior tibial vessels and nerve are to its outer or fibular side, a small bursa separates its tendon from the upper part of the internal cuneiform bone; another bursa in general surrounds it, as it is passing over the synovial membrane of the ankle joint.

Extensor Digitorum Longus, *arises* tendinous and fleshy from the external part of the head of the tibia, from the head of the fibula, and from about three-fourths of this bone, from part of the inter-osseous ligament, from the fascia of the leg, and its inter-muscular septa; the fibres descend obliquely inwards; a little below the middle of the leg they end in three flat tendons, which pass under the annular ligament through a ring common to these and to the peronæus tertius, and extend forwards over the dorsum of the foot, the internal of the three tendons here divides into two; the four tendons now extend along the dorsum of each of the four external toes; the great toe does not receive any, and are *inserted* into the last phalanx of each. *Use,* to extend the toes and flex the ankle. This muscle is superficial; superiorly, it lies between the tibialis anticus and peronæus longus, and is connected to both; in the middle

of the leg it is between the extensor pollicis and peronæus brevis: along each of the toes these tendons sub-divide at the joints between the first and second phalanges, into fasciculi, which pass over the sides of these articulations as the extensor tendons do on the fingers; on the dorsum of the toes also they form a sort of aponeurosis as on the fingers, the tendons of the lumbricales and inter-ossei as also the tendons of the extensor brevis assisting in its formation.

Extensor Pollicis Proprius, *arises* tendinous and fleshy from the inner edge of the middle third of the fibula, and from the inter-osseous ligament nearly as low down as the ankle: a few fibres also proceed from the lower part of the tibia; the fibres descend obliquely forwards to a tendon, which passes beneath the annular ligament, then runs forwards over the astragalus, naviculare, and cuneiforme internum; the tendon next passes over the first metatarsal bone, and is *inserted* by two tendinous fasciculi, one into the base of the first phalanx, and the other into the base of the second or last phalanx of the great toe. *Use,* to extend the great toe and flex the ankle; it may also adduct the foot, and rotate it inwards. The upper and middle portions of this muscle are overlapped and concealed by the tibialis anticus and extensor communis, between which muscles it is situated; its tendon is superficial; the anterior tibial nerve and vessels separate it from the tibialis anticus above, and from the extensor communis below; it lies on the fibula and inter-osseous ligament above; inferiorly it crosses over the tibial vessels, the synovial membrane of the ankle joint, and the bones of the tarsus.

Peronæus Tertius, or anticus, appears to be a portion of the extensor communis, and in some cases cannot be separated from it; it *arises* from the anterior surface of the lower half of the fibula; the fibres pass forwards to a tendon which descends along with that of the extensor communis beneath the annular ligament; it then passes forwards and outwards, and is *inserted* broad and thin into the base of the fifth metatarsal bone, and it frequently sends a band of fibres to join the fourth tendon of the extensor communis. *Use,* to extend the little toe, to flex the ankle, to abduct the foot, and raise its outer edge. This muscle is sometimes wanting, an additional tendon from the extensor communis will then supply its place; it is superficial; on the foot it conceals the extensor brevis, which may be next examined.

Extensor Digitorum Brevis, situated on the upper surface of the foot, *arises* tendinous and fleshy from the upper and anterior part of the os calcis, anterior to the groove for the peronæus longus, also from the cuboid bone, the astragalus, and the annular ligament; it forms a flat fleshy belly, which passes forwards and inwards, ends in four flat tendons, of which the two internal are the strongest; the little toe does not receive any; these tendons are *inserted* thus: the first or most internal, into the base of the first phalanx of the great toe; the three other tendons join the outer edge of the corresponding tendons of the extensor digitorum longus, and assist in forming the aponeurosis which covers the dorsum of each toe. *Use,* to extend the toes and rotate the anterior part of the foot outwards. This muscle is partly concealed by the tendons of the long extensor and peronæus tertius; it projects, however, behind and between them; the tendons cross the metatarsal bones and the inter-ossei muscles, beneath and in a contrary direction to the long extensor tendons.

The muscles on the outer part of the leg are the two peronæi.

Peronæus Longus, *arises* tendinous and fleshy around the head of the fibula, and from the adjacent surface of the tibia, from the upper half of the external angle of the fibula, from the fascia and inter-muscular septa, the fibres descend obliquely backwards and outwards, end in a strong, flat tendon, which passes behind the external malleolus, through a groove in the lower end of the fibula, in which it is bound down by a strong aponeurosis, lined by a synovial membrane; it then passes forwards, downwards, and inwards, through a similar groove in the os calcis and cuboid; it next passes across the sole of the foot, obliquely inwards and forwards towards the metatarsal bone of the great toe, into the outer side of which, and of the adjacent sesamoid bone, it is *inserted;* also, into the internal cuneiform, and into the base of the second metatarsal bone. *Use*, to extend the ankle joint, turn the foot outwards, and raise its outer edge from the ground; in the leg this muscle is superficial, and is situated between the extensor communis anteriorly and the solæus and flexor pollicis posteriorly; in the sole of the foot it is above all the muscles there, and cannot be seen until these are removed.

Peronæus Brevis *arises* fleshy from the outer and back part of the lower half of the fibula, and from the inter-muscular septa; the fibres descend obliquely, end in a tendon which passes behind the external malleolus in the same groove as the peronæus longus; it then passes forwards through a distinct groove in the os calcis above the peronæus longus, and is *inserted* into the base of the metatarsal bone of the little toe, and into the os cuboides. *Use*, similar to the last. This muscle *arises* between the extensor longus and peronæus longus, and descends between the peronæus tertius and the flexor pollicis longus, and partly concealed by the peronæus longus; it continues fleshy lower down than it, and projects on either side of its tendon; it is separated from the peronæus tertius by the external malleolus; in the groove in the latter it is beneath the long peronæal tendon, that is nearer to the bone, but on the os calcis it is superior to it; an aponeurosis sometimes unites its insertion to that of the extensor tendon of the little toe.

In the dissection of the foregoing muscles we meet with the anterior tibial vessels and their branches; also the peronæal nerve and its divisions. The *anterior tibial artery* is a branch of the popliteal; it passes forwards between the solæus and poplitæus, perforates the inter-osseous space, surrounded by some fibres of the tibialis posticus; it then descends obliquely inwards and forwards as far as the cleft between the first and second metatarsal bones; in its course down the leg it is placed at first between the tibialis anticus and extensor communis, in the middle of the leg, between the former and the extensor pollicis, and inferiorly between the tendon of the latter and that of the extensor communis; above it lies on the inter-osseous membrane, below it passes over the tibia, the synovial membrane of the ankle joint, the astragalus, navicular and cuneiform bones and beneath the annular ligament and the internal tendon of the extensor digitorum brevis; in the leg the anterior tibial artery sends off, first, the recurrent branch, which ascends on the outer and fore-part of the head of the tibia, and meets the external articular arteries; second, in its course along the leg, several muscular branches; third, near the ankle, the two malleolar branches, of these, the external is the larger and inosculates with a small artery (the anterior peronæal) which perforates the inter-osseous ligament about two inches above the ankle joint; on the tarsus,

the anterior tibial artery sends off the tarsal and metatarsal branches, which pass obliquely outwards, and supply the inter-ossei muscles, the bones and joints of the tarsus and metatarsus; between the two first metatarsal bones the anterior tibial divides into the superior and inferior branch; the former supplies the integuments of the great toe; the latter passes deep towards the sole of the foot, and joins the external plantar artery; the anterior tibial artery is accompanied by two veins, which end in the popliteal vein. The *peronæal nerve* winds around the head of the fibula, perforates the peronæus longus, and divides into several branches; some of these supply the peronæal muscles, others the integuments on the outer and fore-part of the leg and foot; and the continuation of the peronæal nerve passes obliquely forwards and downwards, and accompanies the anterior tibial artery, lying in general superficial, and to its fibular side.

DISSECTION OF THE MUSCLES ON THE BACK OF THE LEG.

These muscles may be divided into a superficial and a deep layer; the former consists of the gastrocnemius, solæus, and plantaris; the latter of the tibialis, posticus, flexor pollicis longus, flexor digitorum communis and poplitæus. The cutaneous nerves and veins, and the fascia, have been already noticed.

Gastrocnemius, large and thick, tendinous below, fleshy and aponeurotic above, and divided into two heads, both of which are somewhat oval, convex behind, flat before; the internal, longer and larger than the external; *arises* from the upper and back part of the internal condyle of the femur, and fleshy from the oblique ridge above it; the external head *arises* in the same manner from above the external condyle, but is not so long or large; the fibres of each descend converging, and form two fleshy bellies, which unite a little below the knee in a middle tendinous line; about the middle of the leg the muscle ends in a broad and flat tendon, which gradually unites with that of the solæus, and both form that strong tendon which is commonly called the *tendo Achillis*, and which is *inserted* into the lower and back part of the os calcis. *Use*, to extend the ankle joint, and thus, by raising the heel from the ground, to throw the weight of the whole body forwards on the toes as in progression; to flex the knee joint, also to secure the articulation against displacement, by preventing the condyles of the femur slipping backwards off those of the tibia. This large muscle is superficial, a small portion of its internal head is overlapped by the semi-membranosus; its deep surface is more aponeurotic than its superficial; the lower angle of the popliteal space separates its two heads; in this angle the popliteal vessels, the posterior tibial nerve, and the plantaris muscle are contained; a bursa is placed between each head of this muscle and the condyle of the femur, which it covers; the external head conceals the tendon of the poplitæus; the internal covers the deep processes of the semimembranosus tendon and an intervening bursa, also the insertion of the poplitæus; the gastrocnemius covers the greater part of the solæus, therefore, to examine the latter, detach the heads of the gastrocnemius from the condyles, and separate this muscle from the solæus to within two or three inches of the heel; the plantaris muscle is now also exposed.

Plantaris *arises* fleshy from the back part of the femur above the external

condyle, and from the posterior ligament of the knee; it is connected to the external head of the gastrocnemius, and forms a small pyramidal fleshy belly, which descends obliquely inwards, crosses the popliteal vessels, and ends in a flat tendon (the longest in the body) which descends between the gastrocnemius and solæus; and when the tendons of these muscles are about to unite, that of the plantaris becomes superficial, it then descends along the inner side of the tendo Achillis to the heel, and is *inserted* into the posterior part of the os calcis, a little anterior to the tendo Achillis; it has also some connection to the plantar fascia. *Use*, to extend the foot, and turn it inwards, also to make tense the fascia, and to flex the knee; its origin is partly concealed by the external head of the gastrocnemius; its tendon also is at first covered by this muscle, but inferiorly it is superficial. This muscle is sometimes wanting.

Solæus, of an oval flattened figure, consists superiorly of two heads, which are not so distinct from each other as those of the gastrocnemius; the external is longer and larger than the internal, and *arises* from the back part of the head and from the superior third of the fibula, behind the peronæus longus; the internal head *arises* from the middle third of the tibia commencing below the oblique insertion of the poplitæus; the two heads are connected by a strong tendinous arch, beneath which pass the posterior tibial nerve and vessels; all the fibres descend and form a large oval belly, which continues fleshy lower than the gastrocnemius; a tendon is formed first on its superficial surface, which is gradually united to that of the gastrocnemius to form the tendo Achillis; this strong tendon is broad and thin above, narrow in the middle, and round and thick below, it is composed of strong vertical fibres which descend behind the os calcis, over a bursa covering a cartilaginous impression on that bone, and it is *inserted* into a rough surface below that. *Use*, to assist the gastrocnemius in extending the ankle; this muscle is almost entirely concealed by the gastrocnemius; a little below the middle of the leg, however, it projects on each side of the tendon of the latter, and forms the lower calf of the leg; it covers the deep seated muscles, vessels, and nerves.

Detach the solæus from its origin, and the strong deep fascia of the leg is exposed; this fascia is partly derived from the semi-membranosus and poplitæus, and partly from the more superficial fascia of the leg; it adheres to the tibia and fibula, to the solæus and to the deep muscles; inferiorly this fascia is strong, and is connected to the sheaths of the tendons that pass behind the melleoli, and to the internal annular ligament of the ankle; dissect off this fascia and clean the four following muscles.

Poplitæus, situated obliquely at the upper and back part of the leg, behind the knee, and above the other muscles in this region, flat and triangular, *arises* by a round tendon from a depression on the outer condyle, descends obliquely inwards and backwards, above the head of the fibula, and along the external semi-lunar cartilage, to which it is connected by the synovial membrane of the knee, and by a few tendinous fibres; becomes broad and fleshy, and is *inserted* into a flat triangular surface, which occupies the superior fifth of the posterior surface of the tibia. *Use*, to bend the knee, and when bent, to twist the foot and toes inwards; it may also assist when the limb is extended in rotating the knee outwards; it supports the external semi-lunar cartilage, and moves it slightly, so as to adapt its situation to the external condyle of the

femur, in the rotatory motions of the joint; the poplitæus is covered by the gastrocnemius and plantaris, also by the external lateral ligament, the popliteal nerve and vessels; it is superior to the solæus, and passes over the tibio-fibular articulation and the back part of the tibia; it is nearly parallel to the upper part of the plantaris; the tendon is nearly surrounded by the synovial membrane of the knee, it lies however external to the cavity of the joint.

Flexor Digitorum Perforans, broader in the centre than at either end, *arises* fleshy from the posterior flat surface of the tibia, commencing below the poplitæus, and extending to within two or three inches of the ankle, also from the fascia and inter-muscular septa; the fibres descend obliquely inwards to a tendon which passes behind the internal malleolus, in a groove in the tibia which is lubricated by a bursa, and in which it is confined along with the tendon of the tibialis posticus by the internal annular ligament, separated, however, from that tendon by a ligamentous septum, each tendon also has a distinct synovial sac: this tendon then turns forwards and a little outwards into the sole of the foot, still confined in a bony groove, first in the astragalus, and then in the os calcis; in the sole of the foot it lies beneath the tendon of the flexor pollicis, and is connected to it by a tendinous slip; about the centre of this region it expands and receives the insertion of the accessory muscle, it then divides into four tendons, which pass to the four outer toes, and opposite the first phalanx, each tendon enters a strong fibrous sheath which is lined by synovial membrane; this sheath continues as far as the extremity of the second phalanx, and contains also the corresponding tendon of the flexor digitorum brevis; opposite the base of the second phalanx; each of the last named tendons is slit for the transmission of the long flexor tendon, which continues to run forwards to be *inserted* into the last phalanx of each of the four lesser toes. *Use*, to flex the toes and the metatarsus, to extend the ankle, and to steady the leg on the foot as when standing. This muscle in the leg is covered by the superficial muscles, the deep fascia, and the tibial vessels; it overlaps the tibialis posticus, and is on the inner or tibial side of the flexor pollicis; a little above the inner ankle, the tendon of the tibialis posticus crosses above that of the flexor communis, that is, becomes nearer to the tibia; in the sole of the foot its direction is horizontal, it is there superior to the flexor brevis, inferior to the transversalis pedis and peronæus longus tendon; the lumbricales muscles arise from its tendons.

Tibialis Posticus, larger above than below, *arises* from the posterior and internal part of the fibula, from the upper part of the tibia, and from almost the entire length of the inter-osseous ligament; the fibres descend, and end in a strong tendon which passes along with that of the last muscle behind the internal ankle, crosses above that tendon, and then proceeds obliquely forwards and inwards, and is *inserted* into a tuberosity on the inferior and internal part of the os naviculare, and into the internal cuneiform bone; it also sends some fibres to the cuboid and to the second and third metatarsal bones; a small bony or cartilaginous tubercle is often found in this tendon, near to its insertion, beneath the head of the astragalus; it also glides over a small bursa in this situation. *Use*, to extend the ankle, and to raise the inner edge of the foot from the ground; the upper end of this muscle is notched by the anterior tibial vessels, a few of its fibres accompany these vessels through the inter-osseous space, and are attached to the anterior surface of the

ligament; in its course down the leg it is covered by the solæus, and overlapped by the flexor communis and flexor pollicis, it covers the tibia, fibula, and inter-osseous ligament; it passes beneath the head of the astragalus, and supports that strong fibro-cartilage, which extends from the os calcis to the os naviculare, beneath the head of the astragalus, which substance supports a great portion of the weight of the body in standing or in progression.

Flexor Pollicis Longus *arises* from the two inferior thirds of the fibula, by fleshy fibres, which descends obliquely inwards to a tendon which passes behind the internal malleolus through a groove first in the tibia, and next in the astragalus; entering the sole of the foot this tendon crosses above the flexor communis, and is connected to it by a tendinous slip, it then proceeds forwards and inwards, between the two portions of the flexor pollicis brevis, enters a tendinous sheath, and is *inserted* into the last phalanx of the great toe. *Use*, to flex this toe, to extend the ankle and adduct the foot: this muscle lies to the fibular side of the tibialis posticus, between it and the peronæi muscles; as it passes behind the internal ankle it is about half an inch behind the tendons of the tibialis posticus and the flexor communis, and is separated from these by the posterior tibial nerve and vessels.

§ 5.—*Dissection of the Muscles of the Foot.*

There is but one muscle on the dorsum or on the upper surface of the foot, the extensor digitorum brevis, which has been already examined, as being a sort of appendix to, or continuation of the long extensors of the toes which arise from the bones of the leg. The integuments and fascia in the sole of the foot have been already noticed; the muscles here are very numerous, they may be divided into four laminæ, these are tolerably distinct about the middle of this region, but at either side this arrangement is rather artificial; the two inter-muscular processes of the plantar fascia also divide these muscles into three compartments, an internal, a middle, and an external. The muscles of the first or superficial layer, are the abductor pollicis, flexor digitorum brevis, and abductorminimi digiti; in the second layer are the long flexor tendons, the accessory muscle and the lumbricales; the third layer consists of the flexor pollicis brevis, adductor pollicis, transversalis pedis, and flexor minimi digiti; in the fourth layer, are the interossei muscles, and the tendon of the peronæus longus.

Abductor Pollicis, *arises* tendinous and fleshy from the lower and inner part of the os calcis, from the internal annular ligament, the plantar aponeurosis, and internal inter-muscular septum; the fibres pass forwards and inwards, and are *inserted* tendinous into the internal sesamoid bone, and into the internal side of the base of the first phalanx of the great toe. *Use* to separate the great toe from the others; this muscle is by some writers called the adductor pollicis, its action being then referred to the mesial line of the body; it is the most internal of the plantar muscles and is superficial, the fascia covering it is very thin.

Flexor Digitorum Brevis Perforatus, *arises* from the inferior and rather from the internal part of the os calcis, from the internal annular ligament, the plantar aponeurosis and inter-muscular septa; it forms a fleshy mass, which passing forwards divides about the middle of the foot into four delicate tendons, which ccompany the flexor longus communis into the tendinous and

synovial sheaths, beneath the phalanges of the four outer toes; each tendon is slit opposite the base of the second phalanx, and having transmitted the long flexor tendon, this short tendon is then folded out on the inferior surface of the second phalanx, and is *inserted* into it, above the long flexor tendon. *Use*, to assist the long flexor, to strengthen the plantar fascia, and to preserve the arch of the foot; this muscle is immediately above the strong central portion of the plantar fascia, from which a considerable portion of it arises, it therefore always presents a rough surface when dissected; it is beneath the long flexor tendons, the accessory muscle and the lumbricales; it is joined to the abductor pollicis posteriorly, but anteriorly is separated from it by the tendon of the flexor pollicis longus; the fourth or the external of its tendons, or that for the little toe is sometimes wanting.

Abductor Minimi Digiti, is situated along the outer edge of the foot, *arises* tendinous and fleshy from the outer side of the os calcis, and from a strong ligament which extends from this to the fifth metatarsal bone, also from the base of the latter, from the plantar fascia and its external inter-muscular septum; *inserted* tendinous into the outer side of the base of the first phalanx of the little toe, and into the adjoining surface of the metatarsal bone. *Use*, to separate the little toe from the others, and to flex it; this muscle is also superficial, the fascia covering it is very strong, it is the most external of the muscles in this region. Detach this first layer of muscle from their posterior attachments, and throw them forwards towards the toes; the tendons of the flexor pollicis and communis are now exposed, also the accessory muscle and the lumbricales; all these constitute the second layer of the plantar muscles.

The tendon of the flexor longus digitorum communis is seen passing from the inner side of the os calcis to the middle of the plantar region, where it divides into its four tendons, which have been already described as entering the sheaths on the inferior surface of the four outer toes, passing through the slits in the tendons of the flexor brevis, and then inserted into the last phalanx of each toe. The tendon of the flexor pollicis longus is now also seen passing above the former, to which it is united by a tendinous fasciculus, and then proceeding forwards to the great toe.

Musculus Accessorius, or flexor digitorum accessorius, *arises* fleshy and tendinous from the inferior and internal part of the os calcis, forms a flat and somewhat square fleshy belly, which proceeding forwards, is *inserted* into the upper and outer part of the tendon of the flexor digitorum longus, just before it divides. *Use*, to assist the long flexor, and to counteract its obliquity; this muscle lies above the flexor digitorum brevis.

Lumbricales are four small muscles which *arise* tendinous and fleshy from the tendons of the flexor digitorum longus; there is none for the great toe; the first or the internal one is the largest; these four muscles proceed forwards along the internal edge of the long flexor tendons, each ends in a thin aponeurosis, which is *inserted* into the internal side of the first phalanx of the four lesser toes, and joins the tendinous expansion of the extensor tendons on the dorsum of the toes. *Use*, to adduct and to assist in flexing the four toes, they may also extend their second and last phalanges. These muscles are covered in the sole of the foot by the superficial layer; their tendinous insertions are superficial, and are best seen on the dorsum of the toes. Detach this second layer of muscles and throw it also forwards towards the toes.

The third layer of the plantar muscles consists of the flexor pollicis brevis, adductor pollicis, transversalis pedis, and flexor minimi digiti.

Flexor Pollicis Brevis, narrow posteriorily, broad and notched anteriorily; *arises* by a strong tendon from the lower and anterior part of the os calcis, also from the external cuneiform bone, it forms a fleshy belly, which passes forwards and inwards, and divides into two short tendons; these are *inserted* into the sesamoid bones beneath the first phalanx of the great toe. *Use,* to flex the first joint of the great toe, also to approximate this toe to the others. This muscle forms a sort of sheath for the tendon of the flexor pollicis longus.

Adductor Pollicis, is situated external to the last muscle, or more in the centre of the foot; it is also inseparably attached to it; it arises tendinous and fleshy fron the strong calcaneo-cuboid ligament, and from the base of the second and third metatarsal bones, it passes forwards and inwards, and is *inserted* along with the external portion of the last muscle into the external sasamoid bone. *Use,* to draw the great toe outwards towards the other toes, also to flex it, so as to bring the great toe beneath the other toes. By some this muscle is name the abductor pollicis, its action being then referred to the mesial line.

Tranversalis Pedis, *arises* by distinct fleshy slips from the anterior extremities of the four external metatarsal bones; the fibres pass inwards and forwards, converging to the external sesamoid bone of the great toe, into which they are *inserted* along with the last described muscle. *Use*, to approximate the toes, and to contract the transverse arch of the foot; behind this muscle the strong calcaneo-cuboid ligament is observed, also the tendon of the tibialis posticus dividing into several slips, which are inserted into the adjacent bones and ligaments.

Flexor Brevis Minimi Digiti, *arises* tendinous and fleshy from the cuboid and fifth metatarsal bone, and from the sheath of the peronæus longus tendon; it passes forwards and outwards, and is *inserted* into the inner side of the base of the first phalanx of the little toe. *Use*, to flex and adduct this toe. This muscle is connected to the abductor minimi digiti; it fills up the concavity of the fifth metatarsal bone. Detach these four muscles in this layer from the tarsus, and the fourth layer will come into view, namely, the tendon of the peronæus longus and the interossei muscles; the former crosses the foot obliquely forwards and inwards from a deep groove in the cuboid, beneath the cuneiform and metatarsal bones, to be *inserted* into the internal cuneiform, and into the base of the first and second metatarsal bones; in this course this strong round tendon is enclosed in a tendinous sheath, which is lined by synovial membrane, and is attached to the several projections of the adjoining bones. *Use,* to serve as a strong transverse ligament in strengthening the tarsus and metatarsus in that direction; this course and connection of the tendon explains the action of the peronæus longus muscle, namely, to extend the ankle joint, to elevate the external side of the foot, to depress its internal side, and to turn the point of the foot outwards.

Interossei Muscles are seven in number; three are seen in the sole of the foot, and four on the dorsum; they fill up the interstices between the metatarsal bones: the three inferior are named *interossei interni* or *inferiores;* they *arise* tendinous and fleshy from between the metatarsal bones of the four

external toes, and are *inserted* tendinous into the inner side of the base of the first phalanx of the three lesser toes. *Use,* to abduct the toes.

The *first* of the inferior interossei is situated between the second and third metatarsal bones, it *arises* chiefly from the inner side of the latter, and is *inserted* into the inner side of the first phalanx of the third or middle toe; this may be named the *adductor medii digiti;* the *second* is between the third and fourth metatarsal bones; *arises* chiefly from the inner side of the latter, and is *inserted* into the inner side of the first phalanx of the fourth toe, and may be named *adductor quarti digiti;* the *third* is between the fourth and fifth metatarsal bones, *arises* from the latter, and is *inserted* into the inner side of the little toe, and may be named the *adductor minimi digiti.*

The *interossei externi* or *superiores* are four in number, are larger than the last, and are seen on the dorsum or convex surface of the foot; they are bicipital muscles; the *first* is between the first and second metatarsal bones and may be named the *adductor digiti secundi;* it *arises* from the internal side of the second metatarsal bone, and by a distinct fasciculus from the outer side of the first; these two origins are separated by the deep branch of the anterior tibial artery; the fibres end in a tendon which is *inserted* on the inner side of the base of the first phalanx of the second toe; it also joins the corresponding extensor tendon. *Use,* to approximate the second to the great toe.

ABDUCTOR DIGITI SECUNDI is placed between the second and third metatarsal bones; *arises* from their opposite surfaces, but chiefly from that of the former; the fibres end in a tendon which is *inserted* into the outer side of the first phalanx of the second toe. *Use,* to separate the second from the great toe.

ABDUCTOR DIGITI MEDII is placed between the third and fourth metatarsal bones, and *arises* from their opposite surfaces, but chiefly from that of the third; the fibres end in a tendon which is *inserted* into the outer side of the first phalanx of the third or middle toe. *Use,* to separate the third toe from the first and second.

ABDUCTOR DIGITI QUARTI is situated between the fourth and fifth metatarsal bones; it *arises* from their opposite surfaces, and is *inserted* into the outer side of the first phalanx of the fourth toe. *Use,* to separate the fourth toe from the three internal.

All the interossei muscles serve to strengthen the metatarsus, to press the metatarsal bones together; they also serve to flex the first joint of the four outer toes, and may assist in extending their last phalanges; these muscles can exert no influence on the great toe; there is only one muscle between the two first metatarsal bones; between the others there are two, therefore there are four superior or dorsal interossei muscles, but three inferior; the latter are situated more in the concavity of each metatarsal bone than between these bones; the superior are stronger and more tendinous than the inferior, and are only partially covered by the long and short extensor tendons.

In dissecting the muscles on the back of the leg, and those in the sole of of the foot, we meet the posterior tibial artery and nerve, and their principal branches. The posterior *tibial artery* is the larger branch of the popliteal; it descends obliquely inwards beneath the deep fascia and the superficial muscles, and over the tibialis posticus and flexor communis to the fossa between the heel and inner ankle, it here ends in the two plantar arteries; in this course it gives off many muscular branches, also the *peronæal artery;* the

latter arises from the tibial, about an inch below the poplitæus; it descends obliquely outwards along the back part of the fibula beneath the flexor pollicis longus; behind, and a little above the outer ankle, it divides into the anterior and posterior peronæal arteries; the former perforates the interosseous space and joins the external malleolar artery; the latter descends between the external ankle and the heel, and is distributed to the ligaments and adipose substance in that region.

The two plantar branches of the posterior tibial artery are distributed to the muscles and integuments of the foot and toes; the *internal plantar* is the smaller of the two, it supplies the muscles along the inner side of the tarsus; the *external plantar*, the larger branch, runs across the foot obliquely outwards, towards the fifth metatarsal bone, between the first and second layers of plantar muscles; from the little toe it next runs obliquely forwards and inwards, towards the first metatarsal bone, above the second layer of the plantar muscles, and between the first and second metatarsal bones it joins the deep branch of the anterior tibial artery, and thus forms the great plantar arch of arteries, from the convexity of which proceed the digital arteries, to supply the toes. (See Anatomy of the Vascular System.) The posterior tibial artery and its several branches are accompanied by corresponding veins, all of which end in the popliteal vein. The *posterior tibial nerve* is the principal branch of the sciatic, it accompanies the posterior tibial artery, at first lying to its tibial, afterwards to its fibular side; in this course it sends off several small branches to the deep and superficial muscles of the leg, and between the heel and ankle it divides into the two plantar nerves, which take the course of the corresponding arteries. In this internal malleolar region, when the integuments, fascia and internal annular ligament are removed, we find the three tendons, the posterior tibial nerves and vessels to have the following relation to each other, the tibialis posticus and flexor communis tendons are bound close to the ankle, about half an inch behind these is the posterior tibial artery accompanied by two veins, the nerve is a little nearer to the heel, and the tendon of the flexor pollicis lies about half an inch nearer to the latter.

PART II.

CHAPTER I.

ANATOMY OF THE NERVOUS SYSTEM.

THIS SYSTEM MAY BE DIVIDED INTO FOUR PRINCIPAL PARTS, THE BRAIN, THE SPINAL CORD, THE NERVES, AND THE GANGLIONS.

§ 1.—*Dissection of the Brain.*

THE brain is subdivided into three portions, cerebrum, cerebellum, and medulla oblongata; these are, however, so intimately connected, that it is difficult to mark the exact limits of each.

Divide the scalp from one ear across the vertex to the other; reflect one flap over the face, the other over the back of the neck; make a circular cut with a saw through the cranium on a level with the cartilage of the ear on each side, anteriorly about an inch above the superciliary arches, and posteriorly a little below the tubercle of the os occipitis. It is only necessary to saw through the outer table of the bones, the elevator, or a few smart strokes with the claw of the hammer will then suffice to crack the internal table (indeed the cranium may be opened by the hammer alone; this plan, however, injures the bones so much as to leave them of little use to the student). The calvarium being now forcibly torn away, the dura mater is exposed; the latter, in some subjects, adheres so closely to the bone as to be torn along with it; this accident will injure the brain, and may be avoided by introducing the handle of the knife or any blunt instrument between the membrane and the bone as you gradually raise off the latter. If the student can procure two subjects it will facilitate his study to examine the brain of both at the same time; in one dissect the parts in situ, and from the other remove the brain in the following manner: commencing anteriorly, gently raise it from the base of the skull, divide each nerve and vessel in succession from before backwards close to the bone, dislocate the pituitary gland from the sella turcica, and cut through the tentorium; next divide the spinal cord as low down in the neck as you can pass the knife through the foramen magnum; then place the brain, its base upwards, in a shallow basin; thus the different surfaces and structures of the brain, as also the several processes and sinuses of the dura mater can be examined in continuation with each other.

The MEMBRANES covering the brain are three, the dura mater, arachnoid membrane, and pia mater; the first may be termed the fibrous, the second the serous, and the third the vascular coat; these three tunics also extend through the spinal canal and cover the spinal cord. The *dura mater* is a fibro-serous

membrane, of considerable strength, and of a whitish color, sometimes it has a bluish tint; the external surface adheres intimately to the bones; it now presents a rough surface, and several red spots, particularly in the course of the sutures; these are owing to the ruptured vessels which passed from the dura mater to the bone, the former being the internal periosteum to the latter; in the young subject the connection between the two is so close and vascular, that is very difficult to separate them in the recent state, and when this is effected, numerous bloody dots are observable on each; this membrane is more intimately attached to the bones at the base of the cranium than in any other situation, it there sends small processes through the several foramina, some of these accompany the vessels and nerves, and are gradually lost on them, others become continuous with the periosteum; the most remarkable of these processes, next to that which is continued along the spinal canal, is one which passes through the foramen lacerum orbitale, and joins the periosteum in the orbit, and another which surrounds the optic nerve, and is united to the sclerotic coat of the eye. Several small arteries ramify on this membrane, between it and the bones of the cranium, anteriorly these are derived from the opthalmic and internal carotid vessels; the middle artery of the dura mater is the largest, this is a branch of the internal maxillary, it enters the base of the cranium, through the spinous hole in the sphenoid bone, passes forwards and upwards above the temporal and sphenoid bones, then ascends obliquely backwards on the inner surface of the parietal bone, the anterior and inferior angle of which it grooves very deeply; posteriorly the dura mater receives several small arteries, viz. branches from the occipital, pharyngeal, and vertebral arteries; these vessels of the dura mater also supply the superincumbent bones with blood. Cut through this membrane parallel to the edge of the cranium, raise it from each side of the brain towards the vertex, leaving a small portion of it in the mesial line, both before and behind undivided; the internal surface is now seen to be smooth and polished, and moistened with a fine serous exhalation: this surface is the reflected or the parietal layer of the arachnoid membrane (to be examined presently), it adheres so closely to the dura mater that it is difficult to separate them for any extent, unless previously macerated.

From the internal surface of the dura mater, folds or processes extend into the cranium, which divide this cavity into several compartments, and support and separate different portions of the brain; these processes are the falx cerebri, tentorium cerebelli and falx cerebelli. The *falx cerebri* is exposed by gently separating one hemisphere of the brain from the other; it commences narrow at the crista galli and middle ridge of the ethmoid bone, thence it ascends in the median line, and passing backwards, ends by being continued into the tentorium; the convex edge of this process corresponds to the middle ridge or groove of the os frontis, to the sagittal edge of the two parietal bones, and to the perpendicular ridge of the occipital; the great longitudinal sinus is enclosed between the layers of this process, the whole extent of this edge; the concave or inferior border of the falx corresponds to the middle line of the corpus callosum, from which it is but a very short distance; the inferior or lesser longitudinal sinus is enclosed in this ridge; the falx divides the cavity of the cranium in the middle line, it separates the hemispheres of the cerebrum, and in different positions of the body supports the weight of each; in

old subjects it is often cribriform, and in some it is partly converted into bone. The *tentorium cerebelli* extends in somewhat a horizontal direction across the posterior part of the cranium; it may be seen by gently raising the back part of either hemisphere of the brain; the convex edge of this fold is attached to the transverse ridge of the occipital bone, to the inferior angle of the parietal bones, to the superior angle of the petrous bones, and to the posterior clinoid processes of the sphenoid; over this last attachment, the concave edge of the tentorium glides and is *inserted* into the anterior clinoid processes; the tentorium is raised and held in a state of tension along the median line by the falx, its inferior surface is concave; anteriorly it presents a large oval opening, which is on a plane anterior to the foramen magnum, this is filled by the superior vermiform process of the cerebellum, the crura cerebri and the pons varolii; along the convex edge of the tentorium, between its layers are two sinuses on each side, the great lateral and the superior petrous, in the median line also is another called the straight sinus, which extends along the base of the falx; the tentorium serves to support the weight of the cerebrum off the cerebellum.

The *falx cerebelli* is seen when the brain is removed; it is a small but thick process of little importance, the base is superiorly attached to the tentorium, the apex inferiorly, at the foramen magnum; its convex edge adheres to the occipital spine, and contains between its layers the occipital sinuses; its concave edge separates the hemispheres of the cerebellum; this process serves to retain the tentorium and falx cerebri in a state of tension. Attached to the lesser wing of the sphenoid bone on each side, is a slight fold of dura mater, termed the *sphenoidal fold;* these serve to increase the surface of the anterior fossæ of the base of the cranium, and correspond to the fissures of Sylvius at the base of the brain. The *uses* of the dura mater are, first to serve as a periosteum; second, to cover the brain; third by its processes to separate and support the different parts of this organ; fourth, to form sheaths for several of the nerves as they leave the cranium; and fifth, to form the sinuses which may be next examined.

The *sinuses* correspond to the veins, or in fact they are veins enclosed between the laminæ of the dura mater, which thus retain them in their situation, and enable them to resist distension; the sinuses are, the superior and inferior longitudinal, the straight, the right and left lateral, the superior and inferior petrous, the right and left cavernous, the circular, the transverse, the occipital and the torcular Herophili. The *superior longitudinal sinus* commences at the crista galli, either in a small cul de sac, or by a small vein from the nose; it extends upwards and backwards along the median line, increasing in size, and opposite the tubercle of the os occipitis it divides into the right and left lateral sinuses, the right branch being in general the larger; with the scissors lay open this sinus through its whole length; it appears somewhat triangular, lined by a smooth fine membrane, which is continuous with that lining the venous system; in general it is usually dilated near the vertex; small white fibrous bands cross it in many places; these have an imperfect resemblance to the valves of veins, and may serve to resist distension of the sinus; they have been named *cordæ Willisii;* about the middle of this sinus there are in general a number of small whitish bodies, sometimes lying singly, but more frequently in clusters, near the openings of some of the veins in the sinus,

these are termed *glandulæ Pacchioni;* their size, number, and appearance, differ considerably in different subjects; in the very young there are few, if any; in the old, they are most numerous; they are found in three situations, in the cavity of the sinus, external to the dura mater, or internal to it; the first are termed the glandulæ mediæ, the second the externæ, and the third the internæ; their use or structure is unknown, most probably they are by no means allied to the glandular system. The longitudinal sinus, like all the other sinuses, consists of two tunics, the internal or the venous membrane, and the external or fibrous coat derived from the dura mater; this membrane is described as dividing into two layers on either side of the cavity; one continues to adhere to the bone, and the other laminæ descend on either side of the sinus, and unite in the falx; the base of the triangular cavity thus formed is towards the bone, the apex towards the falx; in addition to many small veins, from the bones and from the dura mater, this sinus receives near the vertex eight or ten large veins from the upper surface of each hemisphere of the brain, these run obliquely forwards between the coats of the sinus, some for an inch, others for less, before they open into the cavity, and just as they are terminating, they turn slightly, so that their mouths look inwards, or towards those of the opposite side; all the veins which enter the sinus do not take the oblique course now described, and which is most probably designed to impede the reflux of the blood from the sinus into the cerebral veins. The *inferior longitudinal sinus* is not always present, it resembles a small vein enclosed in the lower edge of the falx near its base, it receives small veins from the corpus callosum, and ends in the following; the *straight sinus* is situated in the median line, enclosed between the laminæ of the base of the falx and above the tentorium, it receives the blood from the lateral ventricles returned by the two venæ Galeni; this sinus proceeds backwards and downwards, and ends in the confluence of the two lateral and longitudinal sinuses; it presents internally the same fibrous appearance as the great longitudinal sinus. The *lateral* are the lârgest sinuses, of somewhat an elliptical figure, each proceeds at first horizontally outwards and forwards, enclosed between the laminæ of the tentorium, in a groove in the occipital bone, and in the inferior angle of the parietal; it then descends inwards along the mastoid portion of the temporal bone, and again indenting the occipital, it turns forwards, and passing through the foramen lacerum posterius, ends in the internal jugular vein; each lateral sinus receives several small veins from the posterior lobes of the cerebrum and from the cerebellum; these enter the sinus from without inwards, contrary to the current in the sinus; through each of these sinuses all the blood is returned from the cranium to the general system; there are seldom any transverse bands or glandulæ Pacchioni in these sinuses. The following sinuses are situated on the base of the cranium. The *cavernous sinus* on each side extends from the anterior clinoid process to the point of the petrous bone along the side of the body of the sphenoid; the dura mater in this region divides into two layers, one very thin adheres to the irregular bony surface which bounds this cavity, the other much more dense is reflected over this space, and contains between its laminæ the third and fourth nerve, and the first part of the fifth; the ophthalmic vein opens into the forepart of this sinus, and the two petrosal sinuses lead from it posteriorly to the lateral sinus; this sinus is intersected by tendinous bands, and presents rather

a cellular or spongy appearance like the corpus cavernosum penis; the internal carotid artery and the sixth or abducens nerve pass through the cavity of this sinus, also several small branches from the sympathetic; the venous membrane, however, is reflected around each, so as to separate them from the blood; the cavernous sinuses communicate through the following; the *circular sinus* consists of two small veins, which lead from one cavernous sinus to the other, the anterior is beneath the optic commissure, and before the pituitary gland; the posterior is behind and rather below that body. The *petrosal sinuses* are four in number, two on each side, the superior and inferior; they each lead from the cavernous sinuses backwards, the former along the upper edge of the petrous bone, to the lateral sinuses opposite the inferior angle of the parietal bone; the inferior petrous sinus leads downwards and backwards, over the suture between the petrous and occipital bones, and ends in the lateral sinus near its termination. The *transverse sinus* leads from one inferior petrosal sinus to the other, across the cuneiform process of the occipital bone. The *occipital sinuses* are two small canals contained in the falx cerebelli; they receive veins from the cerebellum, and sometimes from the vertebral canal, and open into the torcular Herophili; these sinuses sometimes extend along each side of the foramen magnum, and communicate with the lateral sinuses: the occipital sinuses are often wanting. The *torculi Herophili* is a sort of common reservoir in which several sinuses end; it is situated opposite the tuberosity of the occipital bone, and enclosed between the layers of the falx and tentorium; it is somewhat oval, and presents six openings, viz. the lateral sinus on each side; the longitudinal sinus above, the straight sinus before, and the occipital sinuses below.

The second covering of the brain is a serous membrane, the *arachnoid*, so fine and delicate that in some situations it is difficult to demonstrate it; between the convolutions of the brain it can be raised from the pia mater, which sinks into the fissures between these; and a little air forced between these membranes will separate them for some distance, and will raise the arachnoid membrane in a vesicular form; on the base of the brain, and in the spinal canal, it is stronger, and can be distinctly detached from the subjacent membrane. The arachnoid membrane covers the whole surface of the brain, and is thence reflected to the dura mater, which it lines throughout, except at the sella turcica, where the pituitary gland intervenes between these membranes; from the surface of the brain it is reflected on the dura mater in several situations, viz. superiorly, as the veins enter the longitudinal sinus, this membrane accompanies them from the brain to the sinus, it is then reflected to the inner surface of the dura mater: inferiorly, also, it surrounds the nerves in their course from the brain to the foramina, through which they pass, and is then reflected on the dura mater, the latter membrane being really perforated and continued for a short distance around each nerve, whereas the arachnoid membrane forms a cul de sac at the exit of each; thus the arachnoid membrane, like all serous membranes, forms a shut sac, one side or layer of it (the parietal) adhering to the dura mater; the other (the visceral) covering the brain and extending from one eminence to another, without penetrating between them; it is smooth, polished, and transparent, without any distinct vessels; it exhales and again absorbs a fine serous halitus which allows the opposed surfaces to move against each other without friction; this membrane is also

continued into the cavities or ventricles of the brain, and gives to them a smooth lining. To see this process ot the arachnoid membrane, separate gently the posterior lobes of the cerebrum, divide the falx, and at the anterior edge of the tentorium the two venæ Galeni will be seen entering the straight sinus; these veins are surrounded by the serous membrane; press these gently to one side, and underneath them a small round hole or canal may be observed, leading forwards below these veins, and above the pineal gland, and opening into the back part of the third ventricle; this canal is lined by the arachnoid membrane, which is continued from that on the surface of the brain, and expands within the ventricles, so as to cover all the inequalities observed within them; this *arachnoid canal,* or the *canal of Bichat,* will be noticed again in the examination of the ventricles. The third tunic of the brain is the *vascular coat,* or the *pia mater,* of a very soft and delicate structure, loaded with numerous fine vessels; it adheres to the whole surface of the brain, and following every involution of its surface, it is intimately united with its substance by numerous shreds and vessels, which admit of being drawn out like fine threads; on the convolutions of the brain it is inseparably connected to the arachnoid membrane, but in most other situations, particularly at the base of the brain, they are but loosely united to each other. The pia mater is also prolonged into the lateral ventricles, through an extensive fissure, which will be seen in the dissection of the brain between the fornix and the corpus callosum above, and the tubercula quadrigemina and pons Varolii below; this fissure descends obliquely forwards on each side into the inferior cornu of each lateral ventricle between the optic thalamus and the hippocampus major; through these lateral prolongations of this fissure, a process of the pia mater enters, termed the choroid plexus, and through the central or transverse portion of it, another process, termed the choroid membrane or velum interpositum; these processes are covered by the arachnoid membrane, and are all connected together, as will be seen in the dissection of the ventricles; this great fissure in the brain is closed every where by the arachnoid membrane on the surface of the brain, except at the foramen of Bichat. The use of the pia mater is to form an exact capsule for the brain, also an extensive surface, on which the vessels divide minutely, and are probably arranged in some peculiar manner, previous to their penetrating the substance of the brain.

There are two modes of dissecting the brain; first, by removing it in successive slices from above downwards; and secondly, from below upwards; the first plan is best adapted for studying the relative anatomy of the different parts of the brain, or for examining this organ pathologically; the second for unravelling its structure; the student should practise both, and first, that from above downwards.

DISSECTION OF THE CEREBRUM.

The Cerebrum is the largest part of the brain of an oval figure, the larger end posteriorly, a little flattened on the sides, convex above, and divided into two equal portions, the right and left hemispheres, by a deep fissure which extends along the median line; this fissure is continued before and behind through the entire depth of the cerebrum, but in the middle it is bounded

below by the corpus callosum; it contains the falx cerebri and the arteries of the corpus callosum; each hemisphere is convex superiorly and externally, and flat internally, or towards the falx, inferiorly very irregular and uneven; the surface of each hemisphere is every where marked by a number of eminences termed the convolutions of the brain; these are of various size and shape, and are somewhat convoluted like the intestines; their round edges are separated by fissures which are closed by the arachnoid membrane; these fissures are nearly an inch deep; they take different directions, serpentine, longitudinal, and oblique; if a section of the cerebrum be made, these fissures will be found to be only involutions of the cineritious substance covering the brain; each fissure therefore is only a continuation of the surface, and is covered throughout by the pia mater.

The cerebrum, on its inferior surface, is also divided into the two hemispheres by the great median fissure at each extremity, and in the centre by a depression containing several substances; each hemisphere inferiorly is divided into three lobes, the anterior, small, triangular, flat, or a little concave, rests on the roof of the orbit, presents a deep groove which lodges the olfactory nerve; the middle lobe is prominent, round, and deep, fills up the middle fossa in the base of the cranium, and is separated from the anterior lobe by a deep fissure, (*fissura Sylvii*) which ascends obliquely outwards and backwards; this fissure corresponds to the sphenoidal fold of the dura mater, and to the lesser wing of the sphenoid bone; the brain above it is perforated by a number of small holes for the entrance of vessels (*pàrs perforee externe*); this fissure contains the middle artery of the brain, and one origin of the olfactory nerve.

The *posterior* lobe rests on the tentorium, and is separated from the middle only by a slight excavation; between the hemispheres we observe, immediately behind the anterior extremity of the median fissure, the lower end of the corpus callosum; posterior to this, and connected to it is the commissure of the optic nerves; behind this is a soft grey substance, the *tuber cinereum*; this is connected anteriorly to these nerves, and posteriorily to two small white bodies termed the *corpora mamillaria* or *albicantia*; these are about the size of small peas, situated behind the tuber cinereum, and attached by it to each other; they are gray internally, although white externally, the anterior pillars of the fornix terminate in these. From the centre of the tuber cinerum a thin conical tube of a reddish color descends, the *infundibulum*; this passes behind and rather beneath the commissure of the optic nerves; it terminates on the surface of the pituitary gland; it is surrounded by arachnoid membrane; it is not pervious inferiorly; above it communicates with the third ventricle. The *pituitary* body is placed in the sella turcica between the dura mater and arachnoid membrane; transversely oval, composed anteriorly of a yellowish substance, which is notched before, and convex behind like a kidney, and posteriorly of a whitish semi-fluid or pulpy substance. Behind the corpora albicantia, we next observe a small triangular depression, closed above by a thin plate which forms the posterior part of the floor of the third ventricle; this is the *middle perforated plate of the brain;* on either side of this is the crus cerebri, connecting the cerebrum to the pons Varolii, which last is situated in the median line behind the last described substances; behind the pons is the posterior extremity of the corpus calosum and between these eminences is the great transverse fissure which transmits the pia mater into the ventricles, and

which also contains the arachnoid canal and the pineal gland: behind this we observe, lastly, the posterior extremity of the median fissure separating the posterior lobes of the cerebrum.

Cut off the upper part of one hemisphere nearly on a level with the corpus callosum, the appearance now presented is termed the *centrum ovale minus*, a mass of white substance surrounded by the irregularly undulating line of gray substance; a small cavity or fissure may now also be observed between the corpus callosum and the lower and internal margin of each hemisphere: next slice off both hemispheres on a level with the corpus collosum, and the *centrum magnum ovale* is presented, that is, a line of gray substance surrounding the central mass of white substance. The *gray* or *cortical* or *cineritious* substance of the brain is soft and pulpy, and more vascular than the white; on the surface of the cerebrum it is about the eighth of an inch in thickness; in other situations it is placed in considerable masses, and covered by the white substance; the shade of its color differs in different parts of the brain, and in different subjects: in the child it is reddish, in the old it is grey or ashy. It consists of a number of very minute globules, connected together by the pia mater and vessels. The *white or medullary substance* is more firm, and when fresh has some elasticity, and in many parts appears distinctly fibrous; its divided surface appears dotted with red spots; these are the divided vessels, they vary in number and size in different subjects; in a very fresh brain, when a section has been made of this white substance, it will, by its elasticity, force the blood to exude out for some little time in small drops from the divided vessels. The *corpus calosum* is now seen in the median line of the cerebrum, but nearer the frontal than the occipital bone, between three or four inches long, convex, white, marked by two or three raised longitudinal lines close and nearly parallel to each other, (*the raphe*,) from these several transverse lines pass to either side; its posterior end broad, round, and a little concave, is bent downwards, and is continuous on either side with the fornix and the hippocampi; its anterior end is also round, and bent downwards and backwards, is continued on each side into the anterior lobes, and in the middle it joins the tuber cinereum and the optic commissure; the corpus callosum connects the white fibrous substance of the hemispheres, and is therefore properly called the great commissure of the cerebrum; it covers the lateral ventricles, the septum lucidum, and the fornix. Divide this substance at a little distance from either side of the raphe, the lateral ventricles will be opened, press the middle portion of the corpus callosum to one side, and the septum lucidum may be seen descending in the median line from it to the upper surface of the fornix. The *septum lucidum* separates the two lateral ventricles, triangular, the apex behind, the base before, the upper end connected to the corpus callosum; the lower edge to the fornix posteriorly, and anteriorly to the inferior curved portion of the corpus callosum; it consists of four laminæ two on each side, gray externally, white internally; between the white laminæ a small cavity exists termed the *fifth ventricle.* This cavity is naturally closed, but when the corpus callosum is divided transversely, and the anterior portion raised forwards, the laminæ of the septum separate, and this cavity becomes distinct; it is larger in the child, but is very irregular in size, and even in existence in different subjects; the septum lucidum appears to be formed by a lamina descending from each side of the raphe of the corpus callosum to the fornix, some gray matter

superadded. Divide transversely the septum lucidum and corpus callosum, raise forwards the anterior portion of the latter, and backwards its posterior part; it will now be seen that this substance is united to the fornix posteriorly, but is nearly an inch above it anteriorly; the septum lucidum is generally so soft that in this stage of the dissection it will have nearly broke down into the surrounding fluid.

The *lateral ventricles* extend from the middle of the brain into the anterior and posterior lobes, also to the inferior part of the middle lobes, hence they are named *tricorne;* the *anterior cornu* of each passes forwards and outwards, and are about an inch distant from each other; the middle portion, or *the body* of each passes horizontally backwards, and are separated from each other by the septum lucidum; near the posterior part of the corpus callosum the posterior and inferior cornua pass off in different directions; the *posterior cornu* proceeds into the posterior lobe at first outwards, afterwards it turns inwards in a curved direction, the concavity towards the median line; the *inferior cornu* descends obliquely forwards and outwards, and is then also curved a little inwards; it terminates behind the fissure of Sylvius and beneath the anterior cornu. The anterior cornu is bounded superiorly and laterally by the corpus callosum, and inferiorly by the large extremity of the corpus striatum; the middle, or body of each, is bounded superiorly and externally by the corpus callosum; internally by the septum lucidum, and inferiorly by the posterior extremity of the corpus striatum, the tænia semicircularis, the optic thalamus, the choroid plexus, and the fornix. The posterior cornu is bounded superiorly and laterally by the medullary substance, and inferiorly by the hippocampus minor. The inferior cornu is bounded superiorly by the optic thalamus, externally by medullary substance; internally it is deficient of cerebral substance and is close by the arachnoid membrane; inferiorly by the hippocampus major and corpus fimbriatum: these several bodies, which are observed in the different regions of these cavities, must next be examined individually; and first, the *corpora striata.* These pyriform bodies have their larger ends directed forwards and inwards; their posterior small and pointed extremities pass backwards and outwards; smooth and unattached superiorly and internally, on all other sides they are continuous with the white substance; vascular, soft, and cineritious on their surface; they will be found, when cut into, to consist of alternate laminæ of gray and white substance; the latter may be traced from the crura cerebri through these bodies to the upper and anterior part of the cerebrum, hence the copora striata are named by some the anterior or superior ganglions of the cerebrum. The *tænia semi-circularis,* a narrow, semi-transparent band, whitish, fibrous, placed in the groove between the optic thalamus and corpus striatum; arises narrow from a tubercle on the back part of the optic thalamus (corpus geniculatum, externum) passes forwards and inwards, becomes broader, and joins the descending pillar of the fornix; the anterior portion has a resemblance to the cornea, and has been named *lamina cornea*; several veins from the corpus striatum pass beneath the tænia to join the venæ Galeni. The *choroid plexus* is a fold of thin vascular membrane derived from the pia mater; it enters the inferior cornu between the optic thalamus and the tænia hippocampi; loose and floating it ascends obliquely backwards over the hippocampus major, then turns forwards between the thalamus and the fornix, beneath which

it is connected to the choroid membrane, and ends by uniting with its fellow in the foramen commune anterius; each choroid plexus is covered by the arachnoid membrane; they receive a number of veins from the parietes of the ventricles, particularly from the corpora striata; these veins join the venæ Galeni, which will be noticed presently; very frequently small vesicles, hydatids and even small hard tumors may be found in these membranes.

The *fornix*, white, fibrous, triangular, is situated horizontally, beneath the corpus callosum and septum lucidum, attached to the former posteriorly, to the latter anteriorly, it lies on the velum interpositum and choroid plexuses; the base posteriorly, *arises*, by two flat bands, the (*posterior pillars* or *crura*,) one from either side, from the hippocamus, major and minor, and from the tænia hippocampi, these crura pass forwards and inwards, and unite (the *body* of the *fornix*); this bends forwards and downwards, over the foramen commune anterius, and divides into two short, round, white cords, (the *anterior pillars* of the *fornix*) these descend behind the anterior commissure, and end in the corpora mammillaria, which are covered with gray substance from the tuber cinerum: the inferior surface of the fornix which rests on the velum is marked posteriorly by several fine oblique lines (*lyra* or *corpus psalloides*). Although the septum lucidum is a partition between the lateral ventricles, yet these cavities communicate together, as also with the third or middle ventricle, though an opening termed *foramen commune anterius*, this is situated in the median line at the anterior part of the body of each ventricle, it is bounded superiorly and anteriorly by the fornix, posteriorly by the two choroid plexuses and velum, laterally it leads from one lateral ventricle to the other, and inferiorly it opens into the third. The optic thalami cannot be fully examined at present. In the posterior cornu of each ventricle is a small eminence, the *hippocampus minor*, large anteriorly, small and pointed behind, white on the surface, gray internally. In the inferior cornu we see the *hippocampus major*, a large white substance, convex externally, concave internally, smooth and white on the surface, gray within, extending all along the floor of the cavity, and ending in a tuberculated expansion, the *pes hippocampi;* along its internal or concave edge, and connected to it, is a narrow white band, the *tænia hippocampi* or *corpus fimbriatum*, the concave edge of which is loose; this substance is directly continuous with the posterior pillar of the fornix; beneath the tænia hippocampi, a narrow cineritious line may be observed, shorter than the tænia, its edge is serrated; this is the *corpus denticulatum*. Divide the fornix about its centre, draw forwards its anterior portion, and the foramen commune anterius will be seen; throw the posterior portion backwards, and the *choroid membrane* or the *velum interpositum* will be exposed; this is of a triangular form, beneath the fornix, and above the optic thalami, the pineal gland, the arachnoid canal, and the third ventricle; the choroid plexuses are united to it laterally and in front, the *venæ galeni* extend along its median line; these veins receive the blood from each plexus, and from the different eminences in the ventricles, they pass backwards, and end in the straight sinus, they sometimes first unite into one trunk; the velum is formed of pia mater, which is continued from the surface of the brain through the great transverse fissure, which is beneath the corpus callosum and the fornix, and above the tubercula quadrigemina and the pineal gland; it is also covered by the arachnoid membrane, which is of extreme

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delicacy; raise this membrane from before backwards, first dividing the small veins which run into it, the optic thalami will be now exposed, and posterior to these the pineal gland, and the superior surface of the tubercula quadrigemina; the anterior extremity of the arachnoid canal also is seen; this orifice is beneath the veins of Galen and above the gland, it is in general surrounded by small granulations; remove the velum. The *pineal gland* is situated above the tubercula quadrigemina, about the size of a pea, cineritious, heart-shaped, the base anteriorly containing, in general, some small sandy particles (the *acervulus*) the posterior part is soft and pulpy, the (*conarium*) is surrounded by a very vascular membrane derived from the velum; unconnected to the brain in every situation, except anteriorly, whence a small transverse medullary band proceeds, which divides into two long delicate processes (*pedunculi*), these pass forwards on the inner surface of the optic thalami, and join the descending pillars of the fornix, at the foramen commune anterius. The *optic thalami*, two firm bodies white on their surface, gray within, placed behind and between the corpora striata, smooth superiorly where they enter into the lateral ventricles, touching each other internally, where they are soft and gray; this connection is termed the *commissura mollis*, it is a broad, soft, and cineritious union between the internal surfaces of the thalami, and anterior to their centre, this must be broken through before the third ventricle can be seen; a sort of fissure separates the thalami; this fissure anteriorly leads to the foramen commune anterius, and posteriorly to the *foramen commune posterius*, this last hole is behind the soft commissure, and between the peduncles of the pineal gland, it is, however, so closed by the velum and the fornix, that no communication can occur through it between the third and the two lateral ventricles, as through the anterior common opening; the optic thalami externally and inferiorly are continuous with the corpora striata and the medullary substance of the hemispheres; inferiorly they present two tubercles; (*corpus geniculatum internum* and *externum;*) their anterior extremity is in the foramen commune anterius, their posterior is in contact with the corpus fimbriatum; the upper surface of each is in the body of the lateral ventricle, the inferior surface is in the inferior cornu: through the substance of the thalami some portions of the crura cerebri pass in their course to the convolutions of the hemispheres, hence they are named by some the inferior ganglions of the brain. Separate the optic thalami, and the third or middle ventricle will be opened. The *third ventricle* is a narrow cavity placed in the median line, bounded on each side by the optic thalami, above by the velum and the fornix, below by the locus perforatus and tuber cinereum, before by the descending pillars of the fornix and the anterior commissure, behind by the posterior commissure and pineal gland, its pedunculi and the tubercula quadrigemina. The foramen commune anterius opens into the upper and anterior part of this cavity; the infundibulum leads from the lower and anterior part downwards and forwards, bewteen the pillars of the fornix and below the anterior commissure, to the pituitary gland; this canal is large above, but it is generally impervious below. From the posterior part of the third ventricle a small canal leads backwards and downwards, above and behind the pons Varolii, and below the tubercula quadrigemina, this is the *aqueduct of Sylvius*, or the *iter ad quartum ventriculum*. The *anterior commissure* is a distinct round cord, extending from one hemisphere to the

other, immediately before the anterior pillars of the fornix, bent like an arch, convex anteriorly, unattached in its central portion, but on each side it is imbedded in the corpus striatum, through which it descends obliquely backwards and outwards, and then terminates in rays near the fissure of Sylvius, and the inferior cornu of the lateral ventricle: it is enclosed in a delicate sheath of pia mater, like a nerve. The *posterior commissure* is shorter and smaller than the anterior, but white, round, and fibrous like it; it extends transversely behind the third ventricle, above the aqueduct of Sylvius, below the pedunculi of the pineal gland to which it is connected, and anterior to the tubercula quadrigemina; its extremities are connected to the optic thalami. The *tuberculi quadrigemina* are below this commissure, and the pineal gland, they are all connected by their bases, on an oblique plane, and separated from each other near their points by two superficial grooves; the two superior and anterior are called the *nates*, the two inferior and posterior the *testes*, white on their surface, gray internally, they lie above and behind the aqueduct of Sylvius which alone separates them from the pons Varolii; the nates are connected to the optic thalami, and the testes to the cerebellum, by two thin white plates, which descend obliquely backwards and outwards, and end in the substance of the cerebellum; these are the *processus a cerebello ad testes;* they diverge towards the cerebellum, and are continuous externally and inferiorly with a thick, round, white process, the crus cerebelli; between these two processes there is a thin lamina extended named the *valve of Vieussens*, or of the *fourth ventricle*, cineritious and very soft, triangular, the apex between the testes, the base attached to the cerebellum, and the sides to the two processes just described; this valve forms the roof of the fourth ventricle. Pass a probe along the aqueduct of Sylvius divide the valve of Vieussens and the cavity of the *fourth ventricle* will be exposed; this is directed obliquely downwards and backwards, between the cerebrum, cerebellum, and medulla oblongata; it is bounded anteriorly by the pons Varolii, in the median line of which is a narrow fissure, the *calamus scriptorius*, from each side of which a few white lines pass off to join the auditory nerve; laterally by the processes from the testes and by the crura cerebelli; superiorly by the valve of Vieussens; posteriorly by the cerebellum, and inferiorly by the reflection of the arachnoid membrane, and of the pia mater from the inferior surface of the cerebellum to the back of the spinal cord; the pia mater is here peculiarly dense, and it sends a small process into the lower part of this cavity, (the choroid plexus of the fourth ventricle,) which is loaded with tortuous vessels, and frequently presents a small number of reddish granular bodies.

Raise either hemisphere of the cerebrum; from its inferior surface, just below the corpus striatum and the optic thalamus, a thick, white fasciculus may be observed descending obliquely backwards and inwards; this is the *crus cerebri;* fibrous and white on the surface, each crus internally contains cineritious substance of a very dark color (*locus niger*); the crura cerebri converge as they descend, and end in the upper extremity of the pons Varolii; the third ventricle is between them, and the tractus opticus of each side surrounds them. The crura cerebri and the following substance can be better examined when the brain is removed from the subject, and the base placed uppermost. The *pons Varolii* is somewhat square, it is placed obliquely on the cuneiform process, between the cerebrum and cerebellum; the fourth

ventricle, the aqueduct of Sylvius and the tubercula quadrigemina, are on its superior and posterior surface; its inferior and anterior surface rests on the bone, and is grooved longitudinally by the basilar artery: its superior extremity receives the crura cerebri, which it surrounds like a ring, hence it is sometimes called the annular protuberance; the crura cerebelli are attached to its sides, and the medulla oblongata to its lower extremity, from which it is distinguished by a deep groove: the pons is of a more firm structure than any part of the brain, its surface is white and fibrous; the superficial layer of fibres run transversely from one crus cerebelli to the other, hence the pons has been named the commissure of the cerebellum; beneath this lamina of transverse fibres a quantity of cineritious substance exists, through which white fibrous substance may be seen to ascend obliquely outwards, in the direction of the crura cerebri. The pons Varolii is described by some authors as a portion of the medulla oblongata; it is, however, so connected with it, as well as with the cerebrum and cerebellum, that it may be considered as equally common to all.

DISSECTION OF THE CEREBELLUM.

Remove the posterior lobes of the cerebrum, divide the tentorium, and the cerebellum will be exposed; transversely oval, raised in the centre, divided into *right* and *left hemispheres* by a deep groove posteriorly and inferiorly, which receives the falx cerebelli, and by a broad notch anteriorly, which is behind the fourth ventricle; the upper surface of each hemisphere is nearly flat, and is marked by a great number of narrow lines which run semicircularly, convex posteriorly; these are fissures into which the pia mater descends, the arachnoid membrane passing over them; these fissures are analogous to those in the cerebrum; they are involutions of the gray substance, the superficial extent of which is thus considerably augmented: the same appearance is also observable inferiorly; the lines, however, are not so numerous or regular as above; some lines pass in very deep into the cerebellum, and divide it into lobes, others are only superficial, and divide it into lobules; the inferior surface of each hemisphere is very convex, and fills the inferior occipital fossæ. Along the circumference of each hemisphere a deep fissure extends, at the bottom of which a white cord is observed; this is the *crus cerebelli* which ascends obliquely forwards and inwards to join the pons Varolii; this great fissure separates the superior from the inferior surface. The central portion of the cerebellum is narrow, and raised superiorly into a small conical process, the *superior vermiform process*, this overlaps the valve of Vieussens, the tubercula quadrigemina, and the processus a cerebello ad testes; inferiorly there is a deep depression, which contains, anteriorly, the commencement of the spinal cord, and posteriorly a large process, the *inferior vermiform*, which is marked by numerous transverse lines or fissures, which divide it into several laminæ or lobules. Divide either hemisphere parallel to, and about an inch from the median line, a thick mass of white substance is seen in the centre, branching out into fine fibres, which extend into the lobes, and again subdivide into fine filaments, which pass to every lamina or lobule on the surface, and are there covered by a thin layer of gray substance: nearly in the centre of this white mass, which is continuous superiorly with the processus ad testem,

and inferiorly with the crus cerebelli, is a small oval mass of gray substance, its edges convoluted or serrated: this is the *corpus dentatum* or *rhomboideum;* the white substance which is continued from the medulla oblongata to the crus cerebelli, appears to run through this, and thus to be increased in quantity: hence it is named by some the ganglion of the cerebellum.

DISSECTION OF THE MEDULLA OBLONGATA.

THE medulla oblongata is that conical portion of white substance which extends from the lower margin of the pons Varolii to the spinal cord, about an inch in length, large above, narrow below, where it passes through the foramen magnum, divided by longitudinal lines into six oval eminences placed parallel to each other; the median line anteriorly separates the two corpora pyramidalia; next to each of these is a slight groove, external to which is the corpus olivare, behind which is a groove and another eminence, the corpus restiforme or the posterior pyramid.

The *corpora pyramidalia* are about an inch long, they arise gradually from the fore-part of the spinal cord above the atlas, ascend parallel to each other, increase in size, enter the pons, and they may be traced though this substance for some extent; the median fissure, which extends along the spinal cord, separates them; near the pons this fissure enlarges into a small hole (foramen cæcum). Dissect off the pia mater from these eminences, endeavor to separate them from each other, and about three quarters of an inch below the pons five or six white bands may be observed ascending obliquely from one corpus pyramidale to the other, the fasciculi of opposite sides perfectly indigitating with each other; these are the *decussating fibres* of the pyramids.

The *corpora olivaria* are oval, large in the centre, white on the surface, and containing within a *corpus dentatum* of gray substance; they are separated by a superficial groove from the former eminences; their upper extremity is continued into the pons Varolii.

The *corpora restiformia* are rather larger than the last behind which they are placed; they are separated from each other by a fissure which is continued from the calamus scriptorius along the posterior median line of the spinal cord; the restiform bodies are continued superiorly into the crura cerebelli, hence they are sometimes named the processus a medulla spinali ad cerebellum.

ORIGIN OF THE CEREBRAL NERVES.

THERE are nine pair of cerebral nerves; their connection to the brain is named their origin; they are distinguished by the terms first, second, third, &c. &c. in every respect, those of the opposite sides are symmetrical.

The FIRST PAIR OR OLFACTORY are situated beneath the anterior lobes of the brain; each *arises* by three filaments, the *external* very long and white from the fissure of Sylvius, below the corpus striatum; the *internal*, also white, from the gray substance at the extremity of the corpus callosum; the *middle* is cineritious, and *arises* from one of the posterior convolutions of the anterior lobe; the three filaments soon unite and form a triangular swelling, from which the nerve proceeds forwards and inwards for about two inches, in a groove in the

anterior lobe, in which it is protected from pressure; it then ends in a soft oval bulb which is placed over the cribriform plate of the ethmoid bone; from this several fine filaments descend through the formina in this bone, and are distributed to the mucous membrane in the nose. The olfactory differ from the other cerebral nerves in figure, course, and structure; prismatic or triangular, the apex is imbedded in the cerebrum; they converge as they leave the cranium; they consist of several striæ, some white, others gray, all very soft; they are not surrounded by arachnoid membrane, but lie above it; they have no distinct sheath, and each ends in a soft gray swelling from which the ultimate filaments proceed, and which leave the cranium by a number of foramina.

The SECOND PAIR or OPTIC are large, soft, and flat posteriorly; round and enclosed in a dense neurilema anteriorly, each *arises* by two bands, one from the natis, the other from the testis; these pass outward beneath the optic thalamus, the first joins the corpus geniculatum externum, the second the corpus geniculatum internum; these roots then unite in a soft flat band, which turns forwards in a semicular course (*tractus opticus*) around the crus cerebri, to which it has a slight attachment, and from which it receives a few fibres; the optic nerves then converge, and unite before the sella turcica in the *optic commissure*; in this flat, white, square substance, which is connected to and receives additional fibres from the tuber cinereum, the two nerves are so confounded that the direction of each is indistinct, and it is uncertain whether they decussate in whole or in part; from the commissure each nerve passes forwards and outwards on the inner side of the carotid and above the opthalmic artery, though the optic foramen, into the orbit; it is then surrounded by a process of dura mater, and proceeding to the back part of the eye, it perforates the choroid and sclerotic coats of this organ, and terminates in the retina.

The THIRD, or MOTORES OCULORUM, are smaller than the optic; each *arises* from the inner side of the crus cerebri, close to the pons, behind the floor of the third ventrical, and between the posterior artery of the cerebrum and the anterior artery of the cerebellum; this round nerve passes forwards and outwards external to the cavernous sinus, through the foramen lacerum orbitale and is distributed to five of the seven muscles contained in the orbit.

The FOURTH or TROCHLEATORES are the smallest of the cerebral nerves; each *arises* by two or three delicate filaments from the valve of Vieussens and from the processus a cerebello ad testem; it takes a long course forwards and outwards between the cerebrum and cerebellum, enters a small canal between the layers of the tentorium, behind the posterior clinoid process, and continues its course along the outer side of the cavernous sinus through the foramen lacerum orbitale to the superior oblique muscle.

The FIFTH or TRIFACIAL or TRIGEMNI are the largest of the cerebral nerves; each consists of nearly one hundred fine filaments, but loosely connected to each other, and very easily detached from the brain; *arises* by two fasciculi, one from the angle between the pons Varolii and the crus cerebelli, the other from the corpus pyramidale in the substance of the pons; these pass together forwards and outwards over the point of the petrous bone in a sort of canal formed of dura mater, and lined by arachnoid membrane, which last is reflected on the nerve, so as to form a cul de sac around it; in the middle fossa of the base of the cranium it expands into a large gray swelling (the *triangular*,

semilunar, or *gasserian ganglion*;) this ganglion is concave posteriorly; convex anteriorly and externally; the dura mater covers and adheres intimately to its plexiform surface; three large branches proceed from it, the *opthalmic*, the *superior* and *inferior maxillary*; the first passes into the orbit through the foramen lacerum; the second leaves the cranium by the foramen rotundum, and the third by the foramen ovale. If the ganglion be raised from the bone, a small fasciculus of fibres may be observed to pass from the trunk of the fifth pair, without entering into the ganglion, to the inferior maxillary nerve; this fasciculus can be traced into the anterior root of the fifth, or into the pons Varolii. When this nerve is detached from the brain, a small nipple-like tubercle is seen on the latter at the point of separation. The fifth pair of nerves resemble spinal nerves, in *arising* by two roots, and in having a ganglion placed on the posterior, to which the anterior is only connected.

The SIXTH OR ABDUCENTES, are of a middle size between the third and fourth; each *arises* from the outer side of the corpus pyramidale, a little below the pons, it passes forwards and outwards, pierces the dura mater behind the body of the sphenoid bone, traverses the cavernus sinus on the outer side of the carotid artery, and is there joined by two or three small filaments from the superior cervical gangloin of the sympathetic nerve, it then enters the orbit through the foramen lacerum, and is distributed to the external rectus muscle; the basilar artery is between the sixth pair of nerves.

The SEVENTH PAIR consists of two portions, the PORTIO DURA or the FACIAL nerve and the PORTIO MOLLIS or the AUDITORY nerve; the facial nerve *arises* from the lower edge of the side of the pons below the crus cerebelli, and rather behind and above the corpus olivare; the auditory nerve or portio mollis *arises* by three or four striæ from the side of the calamus scriptorius and from a small mass of gray substance on the back of the corpus restiforme; these are at first separated by the restiforme, but soon unite into one soft white cord, which passes forwards and outwards and joins the portio dura; the two nerves then pass outwards, the mollis being larger than the dura, which is contained in a groove in the former, and a small blood vessel runs between them; they both enter the meatus auditorius internus, where they soon separate; the facial nerve runs along the aqueduct of Falliopius, which canal opens inferiorly at the stylo-mastoid foramen; this nerve then turns forwards, and is distributed to the side of the face; the auditory nerve descends obliquely forwards, and is distributed to the cochlea and semicircular canals.

The EIGHTH PAIR, or the PAR VAGUM, consists of three portions, the GLOSSO-PHARYNGEAL, the PNEUMO-GASTRIC, and the SPINAL ACCESSORY; the glosso-pharyngeal *arises* by four or five delicate filaments between the corpus olivare and restiform; these unite into one small nerve; the pheumo-gastric or the vagus, *arises* by ten or twelve filaments below the last, but in the same groove; these also unite into one nerve, which, with the glosso-pharyngeal, passes forwards and outwards to the foramen lacerum posterius or jugular, where they are joined by the spinal accessory, which *arises* about the middle of the neck from the side of the medulla spinalis by several small roots; this nerve ascends behind the ligamentum denticulatum, and very near the posterior roots of the spinal nerves; it frequently receives filaments from the roots of these nerves: having passed through the foramen magnum it joins the other divisions of the eighth pair, the inferior artery of the cerebellum having previously passed

between them. The eighth pair of nerves passes through the jugular foramen anterior to the vein and immediately separates into its three portions, the course of which shall be considered afterwards The spinal accessory is distributed to the muscles on the side of the neck; the glosso-pharyngeal to the pharynx and the tongue, and the pneumo-gastric to the lungs and stomach.

The NINTH or LINGUAL nerve *arises* by six or eight fine filaments between the corpus olivare and pyramidale, and behind the vertebral artery; these unite and pass through the lingual or anterior condyloid hole in the occipital bone. The ninth pair of nerves are distributed to the muscles of the tongue.

Before the student dissects the cerebral nerves to their termination, he may examine the spinal marrow, also dissect the brain from below upwards.

CHAPTER II.

DISSECTION OF THE MEDULLA SPINALIS.

THE spinal marrow is contained in a cavity or canal which is bounded by the bodies and processes of the vertebræ and by their connecting ligaments; this organ, like the brain, is surrounded by three membranes, which are continuous with those in the cranium. Place the subject on the fore-part, remove the soft parts covering the spine, and with the saw divide the crura of the spinous processes of all the vertebræ close to the articulating processes, then with the elevator raise the posterior arch of the spinal canal; a quantity of loose reddish cellular tissue intervenes between the bones and the dura mater, which membrane is loosely connected to them, and does not serve the office of periosteum as in the cranium; it is more closely attached to the ligaments and bones anteriorly than laterally or posteriorly.

The *dura mater* of the spinal canal is termed the theca vertebralis; it is continued from the cranium through the foramen magnum, down the spinal canal as far as the third lumbar vertebra, where it divides into several processes, which are continued on the sacral nerves; throughout this extent it regularly sends off a tubular process along each of the spinal nerves; its external surface is smooth and polished. With the scissors divide this membrane along its whole length; its internal surface will be found lined by the reflected layer of the arachnoid or serous membrane.

The *arachnoid* or the *serous membrane* in this region has a corresponding appearance to that in the cranium; it is, however, rather stronger, and more loosely connected to the pia mater, so that air or any fine fluid may be impelled between them; from the sides of the spinal marrow it is regularly reflected along each of the nerves to the dura mater; these several reflections or folds, when examined in succession, are found to be continuous with each other, and assist in forming the following substance, the *ligamentum denticulatum;* this is a narrow membranous and ligamentous band extending along each side of the whole spinal cord, its superior extremity is attached to the dura mater at the foramen magnum; its internal edge is straight and is connected to the pia mater along the side of the spinal cord in the space between the anterior and posterior roots of the spinal nerves; its external edge is

serrated and attached by several pointed processes to the inner surface of the dura mater, near the foramina for the passage of the nerves; each of these processes lies between the anterior and posterior fasciculi of the nerves; its inferior extremity is inserted into the ligamentous substance on the body of the fourth or fifth lumbar vertebra. The ligamentum denticulatum serves to separate the roots of the spinal nerves, also to connect or fix the spinal cord laterally.

The *pia mater* in the spinal canal is more dense than in the cranium, it adheres so closely to the spinal cord as to appear to compress it, which is evident when the cord is cut across; it is not so uniformly vascular as it is on the brain, very large and tortuous vessels, however, extend along its whole length.

The MEDULLA SPINALIS extends from the foramen magnum, where it is continuous with the medulla oblongata as far as the second lumbar vertebra, where it ends in a lash of nerves called *cauda equina;* this organ is almost cylindrical; its transverse diameter exceeds the antero-posterior; a deep narrow fissure extends along the median line posteriorly, and a broad superficial groove anteriorly; at first the medulla spinalis is rather contracted or smaller than the medulla oblongata; but from the fifth cervical to the first dorsal vertebra it is smaller than in any other situation; it then again swells out into an oval bulbous expansion which terminates at the second lumbar vertebra in a point, from which the remains of the ligamenta dentata extend; this lower extremity of the spinal cord is sometimes round, sometimes bifid: the two enlargements of the spinal cord correspond to the origins of the largest nerves, viz. those to supply the upper and the lower extremity. The medulla spinalis appears to consist of the two symmetrical portions united at the bottom of the two fissures by transverse bands or commissures; if either side be divided by a transverse section, it will be found to consist of gray and white substance, the latter placed externally, the former internally, and of a lunated appearance, the concavity looking outwards; some gray substance is also placed transversely, and connects the convexities of these lateral masses. The younger the subject the more distinct is the cineritius substance in the spinal cord. The medullary substance on each side appears to be arranged in three columns, separated by superficial grooves; from these the spinal nerves proceed, and it has been partly ascertained by Majendie and Bell that the posterior roots of these nerves are endowed with sensation only, that the anterior are connected with voluntary motion, and the middle, or those which arise from the sides of the cord, with respiration.

In addition to the spinal accessory nerves, which may be now seen to arise from each side of the medulla spinalis in the upper half of the neck by twelve or fourteen small filaments, and to ascend behind the ligamenta denticulata, the spinal cord gives origin to thirty pair of nerves.

ORIGIN OF THE SPINAL NERVES.

THE spinal nerves are symmetrical; there are thirty pair, which are divided into eight cervical, twelve dorsal, five lumbar, and five sacral; all these nerves arise and terminate nearly in a similar manner; each spinal nerve is at first composed of two roots, an anterior and posterior, each of which consists

of several filaments, which *arise* from the anterior and posterior surface of the spinal cord on either side of the median fissures; these filaments unite into fasciculi; those composing the posterior root are larger than those in the anterior; these two fasciculi or roots are separated from each other by the side of the spinal cord, and by the ligamentum dentatum; they then converge and proceed obliquely outwards and downwards to the dura mater, which they perforate distinctly by two small openings, which, however, are so close, as to appear but one; each fasciculus receives a sheath from the dura mater, they then pass through the inter-vertebral foramen, and in this situation a small oval ganglion is formed upon the posterior root of each, to the surface of this ganglion the anterior root is only connected; immediately on the outer side of this ganglion the two roots unite and form a single cord; this is the proper spinal nerve; after a short course outwards, this divides into two branches, a posterior and an anterior; the former is almost universally the smaller, and is distributed to the muscles and integuments posterior to the vertebral column; the anterior branches of the spinal nerves are much larger; they enter into several plexuses, and supply the muscles anterior to the spinal column, as also the extremities. The superior cervical nerves take nearly a transverse course from their origin to the inter-vertebral foramina; the succeeding nerves are more oblique, and the lumbar and sacral take a longitudinal course, and form their ganglions and subsequent divisions within the spinal canal. The course and distribution of the spinal nerves shall be examined individually afterwards, the student may next dissect the brain from below.

DISSECTION OF THE BRAIN FROM BELOW.

The brain, medulla oblongata, and the upper part of the spinal cord should be carefully removed from the subject; the brain, with the base uppermost, should then be placed in a shallow basin; the cerebellum and medulla oblongata will now fall a little backwards, and all the parts of the base of the brain will be exposed. Raise the pie mater from the fore-part and sides of the medulla oblongata; the several eminences on this organ may be traced upwards to the cerebrum, or to the cerebellum; to follow these the dissector should rather scrape the surrounding substance with the handle or with the back of the knife, then cut it with the edge. In the description of the brain already given, certain differences between the cineritious and the white substances have been stated; it is necessary to recollect that the former is soft, vascular, and pulpy, and that the latter is fibrous; it is an opinion entertaind by many, particularly Gall and Spurzheim, that the gray is the origin or matrix of the white substance, or that the former is a secreting organ, and that the latter consists of fine conducting vessels or filaments; the direction of the fibres in some situations is very distinct; some pass from below upwards and outwards; these are termed the *diverging fibres*, others pass from the surface or circumference downwards and inwards, these are the *converging or uniting fibres*: first proceed to trace these two orders of fibres in the cerebellum.

STRUCTURE OF THE CEREBELLUM.

Trace the restiform body upwards into the crus cerebelli; divide this substance vertically, and the former may be seen continued into the mass of gray

substance in the crus known by the name of corpus dentatum, or the ganglion of the cerebellum; from the inner edge of this a narrow white fasciculus may be traced inwards towards the median line; it there unites with a similar process from the opposite side, and both divide into several fine bands, which diverge and form the vermiform process, (or the primary portion of the cerebellum;) the peripheral extremities of these fibres are covered by cineritious substance, and present, when cut vertically, an arborescent appearance; the remainder, or the principal portion of the restiform body, passes upwards and outwards through the corpus dentatum and then divides into several processes or stalks which diverge through each hemisphere and subdivide into finer branches, each of which is covered by the gray substance on the surface; a vertical section of either hemisphere presents also that arborescent appearance known by the name of arbor vitæ. The converging fibres of the cerebellum are inferior and superior; the latter are very delicate and rather indistinct in their course; they consist of several fibres which issue from the vermiform process and unite in one broad lamina which is thin in the centre, (the valve of Vieussens,) and thick at each side (processus a cerebello ad testes); thus the superior converging fibres connect the cerebellum to the quadrigeminal bodies. The inferior converging fibres are more distinct, they proceed from the cineritious substance in either hemisphere, forwards and inwards, and form the principal portion of each crus cerebelli; they then pass transversely across the pons Varolii and unite with those from the opposite side; thus the superficial lamina of the transverse fibres of the pons form a commissure between the hemispheres of the cerebellum.

STRUCTURE OF THE CEREBRUM.

Remove the pia mater from the anterior pyramids of the medulla oblongata and separate these from each other, the decussating fibres will be seen, through these the pyramid on one side may be said to arise from the spinal cord of the opposite side: as the pyramids approach the pons they are somewhat contracted; on entering this substance they separate into fasciculi, which intermix with cineritious substance; they are considerably increased in size and number in passing through the pons, and they then form the anterior and external two-thirds of the crura cerebri. The olivary body and a few fibres from the restiform of each side also ascend through the pons behind the fasciculi of the pyramids; these also increase in size in passing through the pons and then enter the crura cerebri, the posterior and internal part of which they form. Each crus cerebri contains a mass of cineritious substance of a peculiarly dark color, in passing through which the white fibres appear increased in quantity. The posterior and internal fasciculi of each crus ascend and pass into those masses of gray substance called the optic thalami corpora striata, in passing through these their fibres are increased in number, and thence extend in a radiated manner into the posterior and superior convolutions of each hemisphere, where they are covered by a layer of gray substance. The anterior and external portion of each crus, which is in continuaton with corpus pyramidale, in like manner ascends and expands into fasciculi, which may be traced into the inferior, and external convolutions of each hemisphere. The uneven surface known by the name of

convolutions appears to depend on the unequal length of these diverging fibres; if they were all of equal extent the surface of the cerebrum would be smooth, but as some fall short of others, and all are covered by the gray substance, an uneven or convoluted surface is the result. From this gray substance which covers the surface of each convolution, the converging or descending fibres are described as arising, and thence passing towards the mesial line to unite with those from the opposte side; the corpus callosum and the anterior and posterior commissures are supposed to be thus formed; in addition to these transverse processes there are several other parts which may serve as media of communication between different parts in each hemisphere of the brain, viz. the fornix, the tænia semicircularis, the pineal gland, and its pedunculi, the infundibulum, the septum lucidum, &c. &c.

VESSELS OF THE BRAIN.

The brain is supplied with blood by the two vertebral and the two internal carotid arteries. The *vertebral arteries* are the first branches of the subclavian arteries, each ascends through the series of foramina in the transverse processes of the cervical vertebræ, and passing through the foramen magnum into the cranium, they proceed obliquely forwards and inwards and end in a common trunk called the basilar artery; each vertebral first send off two long and delicate branches, one on the anterior, the other on the posterior surface of the spinal cord, these extend the whole length of this organ, supplying it with blood, and sending out small branches along the several spinal nerves; next to these branches each vertebral gives off the inferior artery of the cerebellum; this turns backwards between the pneumo-gastric and spinal accessory nerves, and is distributed to the inferior surface of the cerebellum.

The *basilar* artery ascends along the median groove in the pons, and at its superior edge divides into four branches, two for each side, viz. the superior cerebellar artery and the posterior cerebral; these are distributed as their names imply: the posterior cerebral artery of each side is joined by the posterior branch of each internal carotid; this communication completes the circle of Willis. Each *internal carotid artery* winds obliquely forwards, upwards, and inwards, through the tortuous canal in the temporal bone, and through the cavernous sinus; beneath the anterior clinoid process it perforates the dura mater, and rises perpendicularly to the base of the brain between the second and third nerves, and then divides into three branches, the anterior, middle, and posterior; before it thus divides it gives off, first, small branches to the cavernous sinus and to the dura mater, and next the ophthalmic artery which enters the orbit through the optic hole and is distributed to the eye and its appendages. The anterior branch of the carotid is also named the anterior cerebral artery, or the artery of the corpus callosum; this passes forwards and inwards, and is joined to the corresponding artery of the opposite side by a short branch, (the anterior communicating artery,) it then ascends and runs along the upper surface of the corpus callosum, distributing its branches to the inner surface of each hemisphere; the middle branch of the carotid is very large, it passes upwards and outwards deep in the fissure of Sylvius, and is distributed to the anterior and middle lobes of the cerebrum; the posterior branch of the carotid is named the posterior communicating artery; it

is small, passes backwards, and joins the posterior cerebral artery; this forms the side of the circle of Willis. (See Anatomy of Vascular System.)—The vessels of the brain are accompanied by numerous fine filaments of the sympathetic nerve, these pass into its substance and supply its intimate structure. The veins of the brain empty themselves into the sinuses which have been already described; the principal veins are on the superior surface of the brain, whereas the large arteries are below.

CHAPTER III.

DISSECTION OF THE NERVES.

The course and ultimate distribution of most of the nerves have been already mentioned in the description of the muscles and of the several regions of the body; in the present chapter they shall be considered in a systematic manner, commencing with the cerebral nerves, the origins of which have been already described.

§ 1.—*Dissection of the Cerebral Nerves.*

Olfactory nerves: from the bulb, which each of these nerves forms at the side of the crista galli, several branches descend into the nose, through the foramen in the cribriform plate; they may be divided into the internal, middle, and external. The *internal branches*, about ten in number, descend in grooves along the septum, subdivide into many filaments which form a plexus with each other in the mucous membrane; some of these can be traced nearly to the floor of the nose. The *middle branches* are distributed to the mucous membrane lining the roof of each nostril. The *external branches* descend along the grooves on the turbinated bones, dividing and communicating frequently with each other, so as to form numerous plexuses, which are lost in the pituitary membrane. All the branches of the olfactory nerves are very soft in the cranium, but in passing through the ethmoid bone they each receive a sheath from the dura mater, which is ultimately lost in the external layer of the mucous membrane.—(See the Anatomy of the Nose.)

Optic Nerves: each optic nerve, on passing through the optic foramen, becomes surrounded by a strong sheath derived from the dura mater; the four recti muscles next surround it, from the fleshy portions of which it is separated by a considerable quantity of soft fat, in which several nerves and vessels are lodged; from the optic foramen this nerve proceeds forwards and a little inwards, so as to be slightly curved, the convexity outwards; at the back part of the eye it is very much constricted; it then pierces the sclerotic and choroid membranes and terminates in the retina. (See Anatomy of the Eye.) The ophthalmic artery accompanies this nerve, in the optic foramen it lies beneath it, it afterwards twines around it to its internal side. In addition to the dura mater, this nerve possesses a very dense neurilema which sends in numerous processes to form small canals or tubes in which the nervous substance is contained, so that this nerve is not composed like other

nerves, of several filaments placed parallel to each other; if the white substance be removed by maceration in alkali, its cellular structure will become obvious.

At the side of the body of the sphenoid bone, the following four nerves of the orbit lie according to their numerical order, viz. most superiorly the third pair, then the fourth, next the ophthalmic branch of the fifth pair, and most inferiorly the sixth or abducens nerve; they are here closely united to each other, forming what may be termed the *orbital plexus*, until they arrive at the anterior clinoid process, where they separate, and as they are entering the foramen lacerum orbitale they lie thus; most superior is the fourth, then the frontal branch of ophthalmic, next the superior division of the third, external to which, and near to the outer wall of the orbit, is lachrymal nerve of the ophthalmic, after these the nasal nerve, below which is the inferior division of the third, and lastly lying inferior to them all, holding the same relation to them as at the cavernous sinus, is the sixth nerve.

To expose these four nerves the orbit should be opened, which is to be done by dividing the orbital plate of the os frontis by two cuts with the saw, these should unite in the optic foramen; the internal is to be carried forward to the superciliary arch about half an inch external to the internal angular process; the external incision is to be carried deeply through the malar bone; a slight blow with the hammer will then throw forwards the roof of the orbit, and the bone will separate easily from the periosteum.

The THIRD PAIR, or motores oculorum, in passing through the foramen lacerum orbitale, divide into two branches, a superior and inferior: the *superior*, or the *smaller*, passes between the heads of the external rectus muscle and over the optic and nasal nerves, and divides into two branches, the smaller and shorter one of which supplies the superior rectus, the other the levator palpebræ muscle. The *inferior* or the *larger branch* passes below and to the outside of the optic nerve and divides into three branches, an internal, middle, and external; the *internal* is the largest, it passes obliquely downwards, forwards, and inwards, beneath the optic nerve, and getting to its internal side is distributed to the internal rectus, the *middle* to the inferior rectus; and the *external*, which is the longest, passes downwards and forwards on the surface of the inferior rectus, between it and the globe of the eye, (it gives no filaments to this muscle,) and is lost in the inferior oblique muscle; this last branch gives off from its root a small short filament to the ophthalmic ganglion. All the branches of the third pair are distributed to the ocular surface of the muscles.

The TROCHLEATOR, or fourth nerve, having entered the orbit by the foramen lacerum, ascends obliquely forwards and inwards above the levator palpebræ and the superior rectus, and is distributed by four or five fine branches to the upper surface of the superior oblique muscle: as this delicate nerve is passing along the outer side of the cavernous sinus, it lies between the third pair and the ophthalmic branch of the fifth, below the former and above the latter and the sixth; as it enters the orbit it mounts above the third and fifth, and is therefore the highest nerve in the orbit both it and the frontal being immediately beneath the periosteum; previous to entering the oblique muscle its size is somewhat increased.

The TRIGEMINI, or the fifth pair, having formed the semilunar or gasserian

ganglion, divides into three branches, the ophthalmic, the superior and inferior maxillary nerves.

The OPHTHALMIC NERVE passes along the outer side of the cavernous sinus below the third and fourth, and above the sixth; in this situation it receives some filaments from the sympathetic nerve; as it approaches the foramen lacerum orbitale, it divides into three branches, the lachrymal, frontal, and nasal, which are situated with respect to the other nerves as above described.

The *lachrymal nerve*, the smallest of the three, passes forwards and outwards to the lachrymal gland above the external rectus muscle and beneath the periosteum, but gives no branches to this muscle; it is surrounded by fat and accompanied by the lachrymal artery; it sends off, in this course, two small branches, one through the spheno maxillary fissure to communicate with the superior maxillary nerve, and the other through the malar bone, to communicate with the facial nerve; near the gland the lachrymal nerve enlarges and sends four or five branches to its inferior surface, and it then terminates in several fine soft filaments on the conjunctiva, lining the superior palpebra and cellular membrane between the gland and malar bone.

The *frontal nerve* enters the orbit, between the superior rectus and the periosteum, along with the fourth, but inferior and external to it; it passes forwards in a kind of groove on the upper surface of the levator palpebræ muscle; and near the superciliary arch it divides into two branches, an internal and external; the *internal* or *supra-trochleator* nerve, the smaller branch, runs forwards and inwards above the trochlea of the superior oblique muscle, and is distributed to the corrugator supercilii, orbicularis palpebrarum, and occipito-frontalis muscles, also to the integuments of the forehead and superior eyelid; it communicates with the nasal nerve, and sends one or two small filaments into the frontal sinus. The *external* branch, or the *supra orbital* or *proper frontal* nerve appears as the continuation of the original trunk, both in size and in direction, it passes through the superciliary notch or foramen, ascends on the forehead, divides into two branches which subdivide into numerous filaments, these chiefly ascend in the muscles and integuments of the scalp, many of them take a very long course, and communicate with the portio dura, with the occipital nerves, and with those from the opposite side. Neither of these two nerves gives any filaments to the muscles in the orbit.

The *nasal nerve* separates from the frontal behind the orbit, enters this cavity beneath that branch, and between the two heads of the external rectus, it then runs obliquely forwards and inwards above the optic nerve and below the superior rectus muscle, and continues its course along the inner side of the orbit below the superior oblique muscle, and here divides into two branches, the external or infra-trochleator nerve, and the internal or the nasal; the nasal nerve, previous to its entrance into the orbit, is joined by a filament from the sympathetic nerve; on the outer side of the optic, and just as it enters this cavity, it gives off a delicate branch about an inch in length, which runs along the outer side of the optic nerve to the lenticular ganglion; as the nasal nerve passes over the optic it gives off two ciliary nerves. The *infra-trochleator* nerve runs forwards beneath the pulley of the oblique muscle and divides into several filaments which communicate with the supra-trachleator nerve, and are distributed to the lachrymal passages, and to the integuments and muscles on the side and dorsum of the nose. The *internal* branch

or the *proper nasal* passes through the anterior of the internal orbital holes into the cranium, crosses the cribriform plate, and descends by the side of the crista galli into the nasal fossæ where it divides into posterior and anterior filaments; the former are distributed to the septum, the latter descend behind the nasal bones and are lost in the integuments at the tip of the nose. The sixth pair of nerves should be next dissected, as it is distributed along with the preceding nerves in the orbit.

Sixth or Abducens Nerve, after traversing the cavernous sinus (where it is joined by branches from the sympathetic nerve) on the outer side of the carotid artery, enters the orbit through the lower part of the foramen lacerum between the origins of the external rectus beneath the other orbital nerves and above the ophthalmic vein; it then passes forwards and outwards, and is distributed to the ocular surface of the external rectus muscle. The different nerves in the orbit have different offices to perform, viz. the second pair is for vision, the third, fourth, and sixth pairs are for supplying muscles, and the ophthalmic nerve is for communicating sensation to the parts within and without the orbit. The student should next examine the *lenticular* or *opthalmic ganglion;* this small body is situated near the back part of the orbit between the optic nerve and the external rectus muscle; it is of a reddish color and surrounded by soft fat; its posterior superior angle receives the filament before mentioned from the nasal branch of the ophthalmic; and its posterior inferior angle receives the twig from the inferior oblique branch of the third pair; these two nerves are described by some as forming this ganglion; from the anterior angles of this ganglion two fasciculi of fine nerves proceed, termed the *ciliary*; the inferior fasciculus is larger than the superior; the ciliary nerves are about twenty in number, eight or ten in the inferior fasciculus, about six in the superior, and three or four internally, which arise from the nasal nerve; the ciliary nerves twine along the surface of the optic nerve, accompanied by the ciliary arteries, and pierce the back part of the sclerotic coat, they then become flat, and proceed forwards in the parallel grooves on the inner surface of that membrane, with very little connection to the choroid coat; at the anterior part of the eye they meet the ciliary ligament, in this substance most of these nerves are lost, hence some consider this as a ganglion; on each side, however, one or two branches may be traced through this into the iris, in which they divide into numerous filaments of extreme minuteness. The student should next proceed to examine the superior and inferior maxillary nerves, the remaining divisions of the fifth pair. Remove the outer wall of the orbit with the saw or hammer, make a vertical section of the nose and face, and separate the globe of the eye and its muscles from their attachments; below the cavity of the orbit the superior maxillary nerve may be seen.

The Superior Maxillary Nerve passes from the middle of the gasserian ganglion forwards through the foramen rotundum into the pterygo maxillary fossa; it here sends off several branches, and continues its course forwards along the infra-orbital canal to the cheek, where it terminates in the infra-orbital nerves; in the pterygo-maxillary fossa it first sends down two small branches along the back part of the superior maxillary bone: these, after a short course, unite in a small triangular reddish substance, called the *spheno-palatine ganglion,* or the *ganglion of Meckel;* this ganglion is embedded in

fat, surrounded by the branches of the internal maxillary artery, and is situated on the external side of the nasal plate of the palate bone, which separates it from the cavity of the nose, behind the tuberosity of the superior maxillary bone, and in front of the pterygoid processes. Three branches proceed from Meckel's ganglion, an inferior, internal, and posterior. First the *inferior* or the *palatine nerve* descends in the bony canal of that name, sends some small twigs through this canal to the spongy bones, and near the palate divides into three filaments, an anterior, middle, and posterior: the anterior passes forwards in a groove within the alveoli and above the mucous membrane, supplying the latter and sending small branches into the bone to the teeth: the middle and posterior filaments of the palatine nerve are distributed to the amygdalæ, the soft palate, and the uvula. The *internal* branch, or the *spheno-palatine* nerve is very short, passes through the spheno-palatine hole into the upper and back part of the nose, and divides into five or six branches; the most of these pass immediately into the mucous membrane, covering the superior and middle spongy bones, one branch called the *naso-palatine nerve*, or *nerve of Cotunnius*, passes beneath the sphenoidal sinus, and descends obliquely forwards along the septum nasi as far as the foramen incisivum, where it communicates with the anterior palatine branches, and where some anatomists describe a small ganglion (naso-palatine) to exist; this, however, can seldom be distinguished from the surrounding fat and vessels. The third or the posterior branch of Meckel's ganglion is the *vidian nerve;* this passes backwards through the vidian canal above the internal pterygoid plate and sends some small filaments into the sphenoidal sinus; it then perforates the cartilaginous substance that closes the foramen lacerum anterius, enters the cranium, and divides into two branches, an inferior and superior; the inferior or carotid branch enters the cavernous sinus, and joins the plexus formed in this sinus around the artery by the ascending branches of the superior cervical ganglion of the sympathetic; the superior branch runs backwards and outwards beneath the dura mater and gasserian ganglion in a groove on the petrous bone, enters the hyatus Fallopii in this bone, and becomes attached to the portio dura nerve, which it accompanies as far as the back part of the tympanum; the vidian nerve then leaves the portio dura, receives the name of *corda tympani*, and enters the tympanum a little below the pyramid; it now proceeds forwards between the long leg of the incus and the handle of the malleus; to the latter it is firmly connected; it then escapes by the hole in the glenoid fissure along with the tendon of the laxator tympani muscle; it then runs downwards, inwards, and forwards, joins the gustatory nerve, and continues attached to it as far as the submaxillary gland; it now leaves the gustatory nerve and unites with some filaments from it in the *submaxillary ganglion*, which is situated near the posterior edge of the submaxillary gland, and from which a number of filaments proceed; these form a plexus which supplies this gland. The superior maxillary nerve immediately after, and sometimes previous to giving off the two descending branches which join the spheno-palatine ganglion, sends off the *orbital branch*, this ascends through the spheno-maxillary fissure and divides into two branches, the malar and temporal; the *malar* communicates with the lachrymal nerve, and is distributed to the integuments and muscles covering the malar bone; the *temporal* branch also passes through the malar bone into

the temporal fossa, pierces the temporal fascia, becomes cutaneous, and joining some branches of the fascial nerve, it accompanies the temporal artery, and is lost in the integuments of the temple and head. The superior maxillary nerve next gives off the *posterior dental nerves;* these are two or three branches which wind round the tuberosity of the maxillary bone, enter small foramina, which lead to the posterior alveoli in this bone, and supply the molar teeth; some branches also supply the gums and the buccinator muscle. As the *infra-orbital nerve*, which is the last branch of the superior maxillary, proceeds along the floor of the orbit, it sends off some small filaments to the fat and muscles in this region, also the *anterior dental;* this descends along the fore-part of the antrum, to the lining membrane of which it gives some fine filaments and is then lost in several branches which supply the canine and incisor teeth: the infra-orbital nerve then escapes through the foramen of the same name beneath the orbicularis palpebrarum and levator labii superioris alaquæ nasi muscles; it here divides into several branches which are distributed to the face, some of these ascend to the palpebræ, others pass outwards to the cheek, and the largest branches descend to the ala nasi and to the upper lip; these different branches have frequent communications on the side of the face with the portio dura, on the nose with the nasal nerves, and on the buccinator muscle they form a plexus with each other and with the buccal and facial nerves.

The Inferior Maxillary Nerve; this, which is the third and largest branch of the fifth pair, immediately passes from the ganglion through the foramen ovale into the zygomatic fossa behind the external pterygoid muscle, where it divides into two large branches, a superior or external, and an inferior or internal. The inferior maxillary nerve consists of two portions, one is plexiform, and proceeds from the gasserian ganglion, the other is concealed by this, and consists of white parallel fibres which do not pass through the ganglion; in the zygomatic fossa this small deep portion winds round the other, becomes anterior to it, and both unite inseparably; the nerve then divides into two branches, superior and inferior; the *superior* or *external* immediately subdivides into the deep temporal, masseteric, buccal, and pterygoid branches; the *inferior* or *internal* division of the nerve is the larger, and subdivides into the auricular, inferior dental, and gustatory nerves. First, the *deep temporal nerves* are two in number, an anterior and posterior, they ascend between the temporal bone and muscle, and are lost in the latter; some small branches escape through the temporal fascia and communicate with the cutaneous temporal nerves. Second, the *Buccal nerve* arises in general in common with one of the last, it passes forwards and downwards between the pterygoid muscles to the external of which, and to the temporal, it sends some branches, it then passes between the coronoid process and the buccinator muscle, and on the latter it divides into several long branches which form a plexus on this muscle with branches of the facial and infra-orbital nerves. Third, the *masseteric* branch descends obliquely backwards and outwards through the sigmoid notch of the inferior maxilla, between the temporal muscle and the neck of the lower jaw, close to the latter, to which also it sends some filaments, it is lost in the substance of the masseter muscle. Fourth, the *Pterygoid branches* are two or three delicate branches which descend to the pterygoid muscle. The deep portion of the trunk of the inferior maxillary

nerve may be traced into these muscular branches. The three branches of the inferior division are the auricular, dental, and lingual nerves; first, the *auricular* or *temporo-auricular* branch; this passes backwards and outwards behind the neck of the lower jaw, and before the meatus auditorius; it here communicates with the facial nerve, and sends small filaments to the meatus and to the cartilages of the ear, also to the articulation of the lower jaw; it then ascends through the parotid gland over the zygoma and divides into an anterior and posterior branch which follow the divisions of the temporal artery, communicate with the facial nerve, and are lost in the integuments on the anterior and lateral parts of the head. Second, the *inferior dental nerve* separates from the gustatory, and is connected to it by a small twig; it descends at first between the two pterygoid muscles, then between the lower jaw and the internal pterygoid; it is here separated from the latter by the internal lateral ligament; about the middle of the internal surface of the ramus of the jaw it sends off a small filament, the *mylo-hyoid nerve* this descends obliquely forwards, confined in a groove in the bone by an expansion from the internal lateral ligament; near the chin it divides into small branches for the mylo-hyoid, genio-hyoid, and digastric muscles. The dental nerve then enters the canal in the lower jaw, which extends from the dental foramen obliquely forwards beneath the teeth as far as the chin; in this course, this nerve, which is accompanied by the dental vessels, supplies each of the molar and canine teeth with soft delicate twigs, and at the mental foramen it divides into two branches, one continues its course within the bone beneath the incisor teeth, the other is the *mental nerve;* this escapes by the mental foramen, bends upwards, and divides in a radiated manner into several branches which pass to the muscles, mucous membrane, and integuments of the lower lip, and communicate with the facial nerve. Third, the *lingual* or *gustatory nerve* is smaller than the dental, to which it is connected by a short branch which encloses a space through which the internal maxillary artery passes; beyond this branch of communication the corda tympani (which has been before traced from Meckel's ganglion) joins the gustatory nerve at an acute angle; the latter is increased in size at this spot; the gustatory nerve is here situated between the external pterygoid and the muscles of the palate and pharynx; it then descends obliquely forwards between the internal pterygoid and the ramus of the lower jaw; it next turns forwards above the submaxillary gland and the mylo-hyoid muscle and lies on the mylo-hyoidean attachment of the superior constrictor of the pharynx, and on the mucous membrane of the mouth and the hyo-glossus muscle, and accompanies the Whartonian duct: it then ascends above the sublingual gland and becomes attached to the lateral and anterior parts of the tongue. In this course the gustatory nerves gives off, 1st, one or two small filaments to the internal pterygoid muscle; 2nd, several to the tonsils, to the muscles of the palate, to the upper part of the pharynx, and to the mucous membrane of the gums; 3rd, the corda-tympani and some accompanying filaments to form a plexus which supplies the sub-maxillary gland; 4th, a few branches which descend along the hyo-glossus muscle to communicate with the ninth or the lingual nerve; 5th, a fasciculus of nerves to the sublingual gland, and to the surrounding mucous membrane; lastly, at the tongue it divides into several branches, some pass deep into the tissue of the tongue, others, which are long and fine, mount towards its surface and are

lost in the mucous membrane and the papillæ at the anterior part of the tongue.

Facial Nerve or Portio Dura of the seventh pair; as this nerve is passing along the aqueduct of Fallopius in the temporal bone it receives superiorly the vidian nerve; at the back part of the tympanum it sends off that nerve again which then receives the name of corda tympani, here it also sends off small twigs to the tensor tympani and stapedius muscles; as it escapes by the stylo-mastoid foramen it gives off three branches, the posterior auricular, stylo-hyoid, and sub-mastoid; the first, or the *posterior auricular*, bends upwards and backwards behind the cartilage of the ear, to which it sends several long branches, others also pass backwards to the integuments covering the mastoid process and occipital bone; the second, or the *stylo-hyoid* nerve, is distributed to the digastric and styloid muscles, and anastomoses with the sympathetic and glosso-pharyngeal nerves; the third, or the *sub-mastoid branch*, perforates the posterior belly of the digastric, supplies it with several filaments, and then communicates with the glosso-pharyngeal nerve around the jugular vein close to the base of the cranium, other filaments descend and join the laryngeal branches of the pneumo-gastric nerve. The fascial nerve then turns forwards across the external carotid artery and through the parotid gland; in this substance it divides into two large branches, the superior or larger is called temporo-facial; the inferior, which is smaller, the cervico-facial; these two branches take different directions, but are still connected together by cross branches which interlace with each other in a plexiform manner; this plexus is named *parotidean plexus*, or *pes anserinus*. The *temporo-facial nerve* ascends obliquely forwards across the neck of the lower jaw; it first communicates with the auricular branch of the inferior maxillary nerve, and then divides into three fasciculi, the temporal, malar, and buccal; these nerves take that course which their name implies; they are all remarkable for the plexiform arrangement of their branches, and for their frequent communications with each other, and with the three divisions of the fifth pair, which are distributed to the face. The *cervico-facial nerve* descends obliquely forwards through the parotid gland towards the angle of the jaw, where it is only covered by the skin and platysma; this nerve also divides into many branches, which may be arranged in three fasciculi, the maxillary, the sub-maxillary, and the cervical; the first, or the *maxillary*, cross the ramus of the jaw and the masseter muscle, and communicate in the muscles of the lower lip with the mental nerve, and with the superior division of the seventh; the second, or *sub-maxillary*, course along the base of the jaw, sending filaments to the integuments and superficial muscles, these also communicate at the chin with the mental nerve; the third, or *cervical* branches, are very long and numerous; they are distributed to the platysma and to the superficial muscles of the neck, and communicate with several filaments of the cervical plexus. The portio dura nerve has been ingeniously supposed by Mr. Bell to be the nerve that excites the muscles of the face in particular conditions of respiration and in the expression of passion, &c., hence he has named it the respiratory nerve of the face; others consider the portio dura as the exclusive motor nerve of the face.

The Auditory Nerve or Portio Mollis of the seventh pair; this nerve separates from the portio dura at the bottom of the meatus auditorius internus,

and then divides into two branches, an anterior and posterior; the anterior passes forwards to the cochlea, penetrates through many small openings, and is distributed to the membrane covering its spiral lamina, and to that lining the canal on its axis: the posterior branch passes outwards, forms a gray swelling, from which proceed several filaments to supply the membrane lining the vestibule and semi-circular canals.—(See Anatomy of the Ear.)

Glosso-pharangeal Nerve, or the first branch of the eighth pair; this small nerve passes through the foramen lacerum posterius by a distinct canal, it then passes downwards and forwards anterior and internal to the jugular vein and carotid artery, and behind the stylo-pharyngeus muscle; it then winds round this muscle to its fore part and descends obliquely inwards between it and the stylo-glossus to the posterior and lateral parts of the tongue; in this course this nerve forms an arch nearly parallel to that which the gustatory and lingual nerves describe; the glosso-pharyngeal is smaller than either of these nerves; it is situated between them, but deeper than either; and has very little, if any, communication with them. As this nerve leaves the cranium it sends one or two small twigs into the temporal bone, these communicate with the carotid plexus in the cavernous sinus; it is next attached to the facial, pneumo-gastric, and sympathetic nerves by small filaments, which are connected together by loose reddish cellular membrane, and entangled with several small vessels. This nerve next gives off some branches to the pharyngeal plexus, some of these descend along the neck, and unite with the sympathetic and cardiac nerves, others ascend to the amygdala, and assist in forming the tonsillitic plexus; as it approaches the pharynx, this nerve gives several branches to the stylo-pharyngeus and hyo-glossus muscles, also to the superior and middle constrictors of the pharynx; several filaments pass between these to the mucous membrane of the pharynx and fauces, also to the folds or arches of the palate and to the epiglottis; the remaining branches of the glosso-pharyngeal nerve are distributed to the muscular substance, papillæ, and mucous membrane at the root of the tongue.

Pneumo-gastric Nerve, or nervus vagus; this large nerve passes through the foramen lacerum in a fibrous canal distinct from the last described nerve, and anterior to the jugular vein; it then communicates with the spinal accessory, glosso-pharyngeal, lingual, and sympathetic nerves; to all these it is closely connected, and the nerve here has the compact appearance, and sometimes the grayish tint of a ganglion; at first it is placed anterior to the vein and to the lingual nerve; it soon, however, passes behind both and opposite the atlas, the vein separates it from the glosso-pharyngeal nerve which lies anterior to that vessel; the vagus then descends along the fore-part of the neck enclosed in the sheath of the carotid artery and jugular vein: in this sheath it is placed between these vessels, rather behind and more closely connected to the vein; on the right side this nerve enters the thorax between the subclavian vein and artery, crossing the latter at right angles; on the left side it is also anterior but nearly parallel to the subclavian artery, a little below which it crosses obliquely the back part of the arch of the aorta; in the thorax these nerves descend at first obliquely backwards behind the roots of the lungs and enter the posterior mediastinum, they then descend along the œsophagus through the diaphragm and terminate on the stomach. Each pneumogastric nerve gives off the following branches; they may be divided into

cervical, thoracic, and abdominal; the cervical branches are, the pharyngeal, superior laryngeal, cardiac and recurrent or inferior laryngeal. First, the *pharyngeal nerve* arises from the vagus near the base of the cranium, and soon receives a twig from the spinal accessory; it descends obliquely inwards behind the carotid artery to the side of the pharynx, divides into several branches, which communicate with those from the glosso-pharyngeal, laryngeal, and sympathetic; all these branches form the *pharyngeal plexus;* this plexus extends along the side of the middle and upper constrictor, and sends numerous filaments to each of these muscles, and to the mucous membrane of the pharynx and fauces. Second, the *superior laryngeal nerve* arises a little below the last; it runs in an arched manner downwards and forwards behind the internal carotid artery, and below the superior cervical ganglion, with which it communicates, as also with the lingual nerve; it sends several filaments to the pharyngeal plexus and then divides into two branches, external and internal; the external is distributed to the sterno and hyo-thyroid, and to the other superficial muscles, also to the thyroid gland and to the cartilages of the larynx; the internal perforates the thyro-hyoid membrane and divides into numerous branches, many of these go to the anterior surface of the epiglottis, to the glands and mucous membrane connected with it, also to the arytenoid glands and muscles; one long filament descends obliquely forwards along the side of the larynx beneath the thyroid cartilage and supplies the crico-thyroid muscle. As the vagus descends it frequently gives off fine filaments to the carotid artery, and to unite with the sympathetic and with the cervical nerves; a little above the arteria innominata the right vagus gives off its *cardiac branches*, these join the cardiac nerves from the sympathetic; the nerve of the left side does not send off so many or such large branches as that on the right side; on the left side they accompany the carotid artery to the arch of the aorta, expand over it, and then join the cardiac plexus. *Inferior laryngeal nerve,* or *recurrent;* that on the right side curves round the subclavian artery, ascends obliquely inwards behind the carotid along the side of the trachea to the larynx; at its origin it gives off some cardiac filaments, afterwards some branches to the fore-part of the trachea and the thyroid gland; it then supplies the lower part of the pharynx and ends in the posterior and lateral crico-arytenoid and in the thyro-arytenoid muscles, also in the mucous membrane of the larynx on which it communicates with the superior laryngeal nerve. The recurrent nerve on the left side is much longer, it curves round the arch of the aorta behind the ligamentous remains of the ductus arteriosus; it gives off several cardiac and pulmonary branches, and then ascends along the œsophagus and terminates in a similar manner to that on the right side. The pneumo-gastric nerves in their course through the thorax send off the pulmonary and œsophageal nerves. The *pulmonary branches* arise from each vagus a little above the roots of each lung; a few of these branches pass to the fore-part of the bronchial tubes and form there a small plexus termed the *anterior pulmonary plexus;* this plexus communicates with the phrenic nerve and sends its fine filaments along the pulmonary vessels to the lungs and pericardium; the greater number of these pulmonic branches pass behind the bronchial tubes to the posterior pulmonic plexus; near the root of the lung each vagus increases in size, its fibres divide, subdivide, and unite in an areolar or plexiform manner, forming the *posterior*

pulmonic plexus; this plexus is very large, lymphatic glands and vessels are entangled in it, and several branches from the sympathetic join it; its numerous filaments accompany the bronchial tubes closely through the substance of the lungs. Below the root of each lung the fibres of each vagus again approximate, and these nerves now become attached to the œsophagus, along which they descend to the stomach, the left on its anterior, the right on its posterior surface; they frequently communicate with each other so as to encircle the œsophagus with a sort of plexus, which is named the *œsophageal plexus*, or *plexus gulæ*. On the stomach the right vagus, which is the largest, passes behind the cardiac orifice, to which it sends several small branches which unite with some from the left or anterior nerve; these form the cardiac plexus which encircles this part of the stomach; it then sends many long filaments to the muscular and mucous coats of the stomach, these communicate with the solar plexus, also with the splenic and hepatic. The left or anterior vagus spreads its branches along the anterior surface of the stomach and the lesser curvature; several of these pass along the lesser omentum to the liver.

The Nervus Accessorius, or the third branch of the eighth pair; this nerve, in passing through the foramen lacerum, is closely connected to the vagus; below the base of the cranium it communicates with the 8th, 9th, and sympathetic nerves, passes behind the internal jugular vein, perforates the upper third of the sterno-mastoid muscle, to which it sends some filaments, it then communicates freely with the cervical plexus, is increased in size, and terminates in the trapezius muscle and the integuments.

The Lingual Nerve, or the ninth pair, on escaping from the condyloid foramen communicates with the eighth pair, the sympathetic, and the nervous arch or loop of the atlas; it is at first posterior to the vessels and nerves in this situation, it then descends along their outer side, soon turns forwards, and becomes superficial to them; it then takes the arched course of the digastric muscle across the neck, parallel but superficial to the lingual artery, and arriving at the side of the base of the tongue above the os hyoides, it passes above the mylo-hyoid muscle and lies on the middle constrictor and on the hyo-glossus, at the anterior edge of which it divides into several filaments, some of these plunge into the lingualis and genio-glossus muscles, others continue on to the point of the tongue, communicating with each other and supplying the muscular substance of this organ. As the lingual nerve is bending across the cheek below the digastric tendon it sends off a considerable branch, the *descendens colli*, or *noni;* this nerve frequently receives a filament from the pneumo-gastric; it descends along the fore-part of the sheath of the carotid artery; about the middle of the neck it is joined by the internal descending branches of the cervical plexus, with which it forms a small triangular plexus, the branches of which pass to the omo and sterno-hyoid and thyroid muscles; on the latter some filaments descend into the chest. Near the os hyoides the lingual nerve sends some filaments to the constrictors of the pharynx and stylo pharyngeus, also one to the thyro-hyoid muscle; on the surface of the hyo-glossus it gives off several branches to the surrounding muscles, some also communicate with the gustatory branch of the fifth pair; the lingual nerve then terminates chiefly in the genio-hyo-glossus muscle.

§ 2.—*Dissection of the Spinal Nerves.*

There are eight cervical nerves, the first passes out above the atlas, and is named the sub-occipital, the eighth passes out above the first dorsal vertebra. All these nerves immediately outside the inter-vertebral foramina, divide into a posterior and an anterior branch; the posterior of each is smaller than the anterior, with the exception of the second cervical nerve, whose posterior branch is very considerable, as it not only supplies the adjacent muscles, but also accompanies the occipital artery and its ramifications in the scalp; the posterior branches of the other cervical nerves are small, they all communicate with each other, and are distributed to the integuments and muscles on the back part of the neck. The anterior branch of the first or the *sub-occipital* passes forwards above the transverse process of the atlas, and supplies the adjoining small recti muscles, then descends before the atlas, and unites with the anterior division of the second cervical, so as to encircle that bone with a nervous loop; in this course the sub-occipital is united by branches to the eighth and ninth, and to the superior ganglion of the sympathetic nerve; with the latter nerve the anterior branches of all the spinal nerves regularly communicate. The anterior branch of the second having received that from the first, descends and joins the anterior division of the third, this in like manner is connected to the fourth; these anastomoses between the anterior branches of the four superior cervical nerves constitute the cervical plexus; the anterior branches of the four inferior cervical are much larger than those of the superior; they are united in like manner to each other, and to the anterior branch of the first dorsal, and constitute the brachial plexus; these two plexuses and their branches the student may next dissect.

The Cervical Plexus is formed by the anterior branches of the four superior cervical nerves, which join each other in arches, from the convexities of which branches arise that again join in a similar manner, a quantity of cellular membrane is entangled in the areolæ between these; this plexus is situated on the side of the neck, on a level with the 2d, 3d, and 4th vertebræ, between the sterno mastoid and trapezius muscles; it sends off several branches which may be classed into ascending and descending; the former consist of superficial and deep, the latter of internal and external: the ascending superficial branches are two or three in number, they ascend obliquely forwards over the sterno-mastoid muscle, supply the platysma and integuments over the parotid gland, also on the ear and on the side and back part of the head, and communicate freely with the portio dura of the 7th pair of nerves; one of these is much larger than the others, is named *superficialis*, or *ascendens colli*, it may be traced chiefly from the third cervical, and is lost near the ear and in the parotid gland; this nerve accompanies the external jugular vein. The deep ascending branches of the plexus, are small nerves which supply the sterno-mastoid, digastric, splenius, and adjacent muscles, and communicate with the neighboring nerves. The descending branches are internal and external, the internal are two, a superficial and a deep; the superficial internal descending branch joins the descendens noni, and assists it in supplying the superficial muscles on the fore-part of the neck. The deep internal descending branch is the *phrenic nerve:* this arises from the lower

part of the plexus, chiefly from the 4th cervical, it has also in general a filament or two from the brachial plexus; the phrenic nerve, or, as it is also named, the internal respiratory nerve descends obliquely inwards, on the anterior scalenus muscle, at the lower part of the neck it communicates with the lower cervical ganglion, and often with the vagus or its recurrent, it then enters the thorax between the subclavian vein and artery, and descends to the diaphragm on the side of the pericardium between it and the pleura; the right phrenic is nearly perpendicular, the left takes an oblique course round the apex of the heart, it is therefore longer and lies more posterior than the right. On the diaphragm these nerves divide into several branches, some of which ramify on the superior surface of that muscle, others on its inferior accompanying the phrenic vessels. These branches on the right side send some filaments to the inferior vena cava and to the liver, and unite with the nerves of this organ and with those of the stomach; on the left side the phrenic nerve sends some filaments to the œsophagus and stomach, these communicate with the vagus and solar plexus. The phrenic nerve can be traced into the spinal canal, and be seen to arise distinctly from the side of the spinal marrow. The external descending branches of the cervical plexus are numerous, some are superficial, others deep, the superficial descend to the clavicle and acromion process, supply the superficial muscles in their course, and terminate in the pectoral and deltoid muscles and in the integuments; the deep branches descend behind the clavicle, supply the deep muscles on the side of the neck and those connected to the scapula; one of these branches is remarkable for its length, it is of the same size as the phrenic, and is named the *external respiratory nerve* of the trunk; this nerve proceeds from the back part of the plexus, chiefly from the 4th cervical, it has also filaments connecting it to the 3d and 2d, and to the phrenic, it descends behind the scaleni muscles and beneath the trapezius and levator anguli scapulæ, and is almost exclusively distributed to the serratus magnus muscle.

The BRACHIAL PLEXUS is formed by the junction of the anterior branches of the 5th, 6th, 7th, and 8th cervical, and of the 1st dorsal; this plexus is broad and flat, the nerves forming it are very large, particularly the inferior; it is situated at the inferior and lateral part of the neck, between the scaleni muscles and above the subclavian artery, it then descends obliquely outwards beneath the clavicle and subclavian muscle and over the first rib, into the axilla, where it rests on the serratus magnus behind the axillary artery and vein. The 5th and 6th cervical unite first, the 7th cervical runs alone for some distance, the 8th cervical and 1st dorsal unite immediately, so that at first this plexus consists of three roots, these however soon unite, and in the axilla again separate and subdivide into several branches: the branches of this plexus are the thoracic, supra and sub-scapular, the internal and external cutaneous, the median, ulnar, musculo-spiral, and circumflex. The *thoracic branches* arise principally from the upper part of the plexus, are four or five in number, and divide into anterior and posterior, the former descend behind the clavicle in front of the axillary artery, subdivide into branches which accompany the thoracic arteries, supply the pectoral muscles, and communicate with cutaneous branches from the intercostal nerves; the posterior thoracic nerves descend behind the vessels to the serratus magnus, posterior scalenus and rhomboid muscles. The *supra scapular nerve* arises from the upper division

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of the plexus, descends obliquely backwards, parallel to the omo-hyoid muscle to the superior costa of the scapula, passes beneath the posterior ligament which converts the notch in this part of the bone into a foramen, it then gives off a considerable branch to the supra spinatus muscle, and proceeds beneath the acromion process and behind the neck of the scapula to the infra-spinous fossa, where it is distributed to the infra-spinatus and teres muscles. The *sub-scapular nerves* are three or four in number, they arise from different parts, but chiefly from the upper division of the plexus, they descend behind the vessels and ramify in the sub-scapular latissimus dorsi, and teres major muscles. *Internal cutaneous nerve*, is a long but delicate nerve, it arises out of the lower division of the plexus, descends nearly perpendicularly along the inner side of the arm, at first covered by the brachial aponeurosis, near the elbow it becomes cutaneous, and runs parallel to the basilic vein, and divides into two branches, an external and internal; the external passes along the border of the biceps over the bend of the elbow to the fore-arm, where it divides into several filaments, some of which descend in the integuments as low as the wrist, and communicate with the other cutaneous nerves; this branch generally crosses the median basilic vein, in some it lies superficial to it, in others behind it; the internal branch descends towards the internal condyle, and divides into several filaments, some of which descend along the inner, and others along the posterior part of the fore-arm, they all terminate in the integuments. *External cutaneous nerve*, or *musculo-cutaneous* or *perforans casserii* is larger than the last, and arises from the upper division of the plexus, it descends obliquely outwards, through the fibres of the coraco-brachialis, and between the brachiæus anticus and the biceps, it then descends along the outer border of the latter to the bend of the elbow, pierces the aponeurosis, becomes cutaneous, and descends along the radial side of the fore-arm to the wrist; in the arm this nerve gives muscular branches to the coraco-brachialis, biceps, and brachiæus anticus, in the latter muscle it frequently communicates with the median nerve. At the elbow this nerve is situated between the biceps and supinator longus, and behind the cephalic vein, along the fore-arm it accompanies this vein, and is often superficial to it; near the wrist this nerve divides into an anterior and posterior branch, the former passes to the ball of the thumb and palm of the hand, the latter to its dorsum. *Median* or *brachial nerve* is the largest branch of the plexus, it generally arises by two roots, a small external one, which is in common with the external cutaneous from the upper part of the plexus, and a large internal one from the lower division of the plexus; the brachial artery in general separates these two roots, which soon unite into one thick cord; it descends obliquely outwards along the inner edge of the biceps, as far as the bend of the elbow, and in this part of its course it is covered only by the skin of the fascia, situated rather to the outer side of the artery above, crossing over it about the middle of the arm, and to its ulnar side below; at the bend of the elbow it passes deep between the supinator longus and pronator teres, and on the brachiæus anticus, perforates the pronator and then descends along the middle of the fore-arm, between the superficial and deep flexors, passes beneath the annular ligament of the carpus, where its size is increased, and terminates in the palm of the hand by dividing into five branches. In the arm the median nerve give but few branches, these are small and unimportant; in the fore-arm it sends

several considerable branches to the superficial and deep pronators and flexors, but not to the supinators, a little below the elbow it also gives off the anterior inter-osseal nerve, this accompanies the artery of the same name, along the anterior surface of the inter-osseous membrane, and supplies the deep flexors; at the pronator quadratus it divides into two branches, one to supply that muscle, the other traverses the inter-osseous space, and is lost on the dorsum of the carpus and metacarpus; a little above the wrist, the median nerve gives off a superficial branch, which passes over the annular ligament, and is lost in the integuments; in the palm of the hand, the median nerve divides into five digital branches, the two first pass one along either side of the thumb, the third goes to the radial side of the index-finger, the fourth supplies the opposed sides of the index and middle finger, and the fifth, which is joined by a small branch from the ulnar nerve, supplies the opposed sides of the middle and ring fingers; these digital branches in the palm of the hand are superficial to the tendons, and form an arch nearly parallel to that formed by the ulnar artery, the branches of the latter and the digital nerves then run together to the extremity of each finger; in this course they supply the lumbricales, the integuments of the hand and fingers, and near the last phalanx of each the nerves enlarge and become red and soft, and divide into numerous fine branches, which are lost in the papillæ of the cutis. *Ulnar nerve* arises from the lower part of the plexus, descends obliquely backwards along the biceps, and behind the elbow joint, through the groove between the inner condyle and the olecranon process; it then passes forwards, and descends along the ulnar side of the fore-arm to the carpus, and passing over the annular ligament close to the pisiform form, ends in the palm of the hand, in two branches, a superficial and a deep. In the arm this nerve is superficial, and gives off a few branches to the triceps and to the skin; in the fore-arm it lies on the flexor profundus, and between the flexor sublimis and ulnaris; to these muscles, particularly the latter, it sends several filaments; a little above the wrist it gives off the dorsalis carpi ulnaris, a large branch which winds round the ulna to the back of the hand, and divides into several long branches which are lost in the integuments of that region and of the three inner fingers. Of the terminating branches of the ulnar nerve, the superficial is the larger, it divides into three branches, which supply the muscles and both sides of the little finger, also the ulnar side of the ring finger; the deep palmar branch passes beneath the flexor tendons, runs across the metacarpus, and assists in forming a deep palmar arch, the branches of which are lost in the inter-ossei muscles. *Musculo-spiral nerve,* is a very large nerve, it proceeds from the middle and lower divisions of the plexus, descends obliquely backwards and outwards between the three portions of the triceps, round the humerus to its external side, it then turns obliquely forwards and downwards towards the elbow between the supinator longus and the brachiæus anticus, and there divides into two branches, an anterior or radial branch, a posterior or inter-osseal branch. In its course down the arm this nerve sends several branches to the triceps, a little above the outer condyle it gives off a large cutaneous branch, which branch descends along the radial side of the fore-arm to the thumb; at the bend of the elbow this nerve sends several branches to the long and short supinators, also to the extensors of the carpus; on the surface of the supinator brevis it expands and divides into its terminating branches; the *anterior* or the

radial nerve descends along the inner side of the supinator longus, which it supplies, and external to the radial artery; about the middle of the fore-arm or a little lower, this nerve passes behind the tendon of the supinator longus, and becoming cutaneous descends behind the radius to the back of the hand, where it divides into two considerable branches, one for the integuments of the thumb, the other expands on the dorsum of the hand and supplies the index and middle finger, and communicates with the dorsalis ulnaris nerve. The *deep* branch of the musculo-spiral nerve or the *posterior inter-osseal nerve*, winds backwards round the upper part of the radius and the supinator brevis, it then descends along the back part of the fore-arm, with the posterior inter-osseal artery, and divides into several branches superficial and deep, which supply the two layers of extensor muscles. *Circumflex* or *articular nerve*, arises from the lower part of the plexus, descends round the lower edge of the sub-scapular muscle, and passing backwards and outwards, leaves the axilla by a large opening between the humerus and the long head of the triceps, above the tendons of the latissimus dorsi and teres major muscles, and below the capsular ligament of the shoulder joint, it then winds round the neck of the humerus, attached to the internal surface of the deltoid; in this course this nerve sends some small branches to the sub-scapular and the adjacent muscles, it then divides into two branches, a superior and inferior, both of which encircle the neck of the humerus, and send their numerous subdivisions into the deltoid muscle.

The Dorsal Nerves are twelve in number, the first pair passes between the first two dorsal vertebræ; and the last pair below the last dorsal vertebra, they also all divide into the posterior and an anterior or intercostal branch; the posterior branches are small, pass backwards between the traverse processes, and supply the muscles and integuments of the back and loins; of the anterior branches that of the 1st dorsal is the largest, it rises above the neck of the first rib, and joins the last cervical in the brachial plexus; the anterior branches of the 2nd and 3d are smaller, they proceed backwards and outwards between the corresponding ribs, and covered internally by the pleura; at the angle of each rib they pass between the intercostal muscles, run along the groove in the lower edge of each rib, supply the surrounding muscles, and opposite the axilla each sends a filament across this cavity to the integuments on the inner and back part of the arm; these filaments are named the *nerves of Wrisberg*, or the cutaneous nerves of the arm; these two intercostal or spinal nerves then continue on in their course below the first and second ribs, and ultimately end in small cutaneous and muscular branches, which are lost in the lateral and fore-part of the thorax; the anterior or intercostal branches of the remaining nine dorsal nerves all pass in a similar manner between the ribs, and supply not only the intercostal but also the adjacent muscles; the last two are chiefly distributed to the abdominal muscles and to the diaphragm; the twelfth dorsal sends a branch close to the vertebræ to join the first lumbar; all these anterior branches of the dorsal nerves opposite the neck of each rib are connected by one or two short branches to the ganglions of the sympathetic.

Lumbar Nerves; of these there are five pair, they are larger than the dorsal, like them they divide into posterior and interior branches; the posterior are distributed to the lumbar muscles; the anterior branches unite with each

other in the substance of the psoas and form the *lumbar plexus*; this long and somewhat triangular plexus is situated along the sides of the four inferior lumbar vertebræ: it communicates above with the last dorsal and below with the first sacral, and divides into the following branches; inguino-cutaneous, anterior crural, obturator and lumbo-sacral. The *inguino-cutaneous* are generally three in number; they descend from the two first lumbar nerves, pass though the psoas, and descend behind the peritonæum; the *first* or the *external* descends obliquely outwards over the quadratus lumborum muscle to the middle of the crest of the ilium it then sends several branches to the abdominal muscles, and divides into a cutaneous branch which passes to the integuments on the outer part of the thigh and into the external spermatic nerve which passes beneath the internal oblique muscle, attaches itself to the spermatic cord, and distributes its branches to the cremaster muscle and to the scrotum in the male, or to the round ligament and labium in the female; the *second* or the *middle, inguino-cutaneous* descends internal to the last, pierces the abdominal muscles close to the anterior superior spine of the ilium, and is distributed to the skin on the outer part of the thigh; the *third* or *internal inguino-cutaneous* descends internal to the last, and divides near Poupart's ligament into two branches; one accompanies the spermatic vessels and is lost on the cord, the other follows the crural vessels and is lost in the integuments and glands of the groin. The *anterior crural nerve* arises in the lumbar plexus from the four superior nerves; it perforates the psoas, descends obliquely outwards along its external side, on the iliacus internus, covered by the iliac fascia, and passes beneath Poupart's ligament about half an inch external to the femoral artery; it is then covered by the fascia lata, becomes flat and broad, and divides into two fasciculi, a superficial and a deep; the superficial separates into four or five long branches which pierce the fascia lata and descends along the inner and fore-part of the thigh to the knee, some of these accompany the saphena vein. The deep fasciculus is larger, it immediately divides into numerous muscular branches which supply the muscles on the outer and fore-part of the thigh; they are divided into the external and internal branches, the former supply the vastus externus, rectus, iliacus internus, and tensor vaginæ muscles; the internal supply the saratorus, vastus internus, and cruræus; three or four accompany the femoral artery near to the knee; two or three of these pass into the adjoining muscles, and one, the *internal saphenus nerve*, continues to descend to the inner side of the knee between the tendons of the gracilis and sartorius; it then becomes attached to the saphena vein, and twines round this vessel as far as the inner side of the foot; in this course it gives numerous filaments to the integuments of the leg.

The *obturator nerve* is smaller than the preceding, it arises chiefly from the third lumbar, it perforates the psoas, and descends obliquely inwards along the inner side of that muscle to the obturator foramen, through the upper part of which it escapes into the groin, where it is covered by the pectinæus, and where it divides into its two branches an anterior and posterior, having previously sent some twigs to the obturator internus; the anterior branch is lost in the adductor brevis, pectinæus, and vastus internus, and communicates with the anterior crural; the posterior branch supplies the gracilis, the adductor magnus and longus. The *lumbo-sacral nerve* proceeds

from the fourth and fifth lumbar nerves into the pelvis, and soon divides into two branches, the superior glutæal and the communicating; the *glutæal* escapes through the upper part of the sciatic notch, and is distributed to the glutæus medius and minimus muscles along with the branches of the glutæal artery; the *communicating* branch joins the first of the following nerves in the sacral or sciatic plexus.

The Sacral Nerves are five pair, they divide within the spinal canal into their anterior and posterior branches, the latter, very small, pass through the posterior sacral holes and supply the muscles and integuments; the anterior branches are very large, particularly the three superior, the two last are much smaller; these five nerves, with the branch from the last lumbar, form the *sacral plexus*, large and flat, placed on the sacrum and pyramidal muscle behind the rectum, and the other pelvic viscera, it sends off the following branches both internal and external; the internal or pelvic are the hæmorrhoidal and vesical, and in the female the uterine and the vaginal; the external branches are the inferior glutæal, the inferior or lesser sciatic, posterior cutaneous, pudic, and great sciatic or posterior crural. The *hæmorrhoidal, vesical, uterine* and *vaginal* branches are all small nerves which arise from the upper part of the plexus, are entangled with accompanying vessels, and interlace with each other; they are distributed to the different pelvic viscera, as their names imply. The *lesser sciatic nerve* escapes from the pelvis with the former and with the sciatic artery, it then passes downwards to the space between the tuber ischii and trochanter major, but nearer to the former, round which it twines, and at its lower part divides into two sets of branches, a superficial and a deep; the former pass over the hamstring muscles with the posterior cutaneous nerve and are lost in these muscles; and the latter pass under the muscles, and are distributed to the quadratus femoris, upper part of the adductor magnus muscles &c. and some go to the hip joint, The *inferior glutæal nerve* leaves the pelvis below the pyriform muscle, and divides at once into several branches, which are principally distributed to the glutæus maximus, some also pass to the perinæum and to the inner side of the thigh. The *posterior cutaneous nerve* arises in common with the preceding from the second and third sacral nerves, escapes from the pelvis below the pyriform muscle, becomes cutaneous, and descends along the back part of the thigh and leg, and communicates with the cutaneous nerves in the latter region. The *pudic nerve* arises from the third and fourth sacral, passes through the great sciatic notch internal to the preceding; it then re-enters the pelvis by the lesser sciatic notch, and passing upwards and forwards along the internal surface of the tuber ischi towards the pubis, it divides into two branches, an inferior and superior; the inferior ascends obliquely forwards and inwards along the ramus of the ischium to the perinæum, and is distributed to the muscles and integuments in that region, also to the scrotum; the superior branch continues its course along the ramus of the pubis nearly to the symphysis, it then passes forwards along the dorsum of the penis, increases in size as it approaches the glans penis, in the subcutaneous cellular tissue of which it terminates; in the female the inferior branch of the pudic nerve supplies the labium, the superior, the clitoris.

The *great sciatic* or *posterior crural nerve* is the principal branch of the sacral plexus, and the largest nerve in the body; it proceeds from the four

superior sacral nerves, escapes from the pelvis below the pyriform muscle, sometimes through it, it then descends along the back of the thigh over the gemini, quadratus, and adductor magnus as far as the ham, where it divides into the external and internal popliteal nerves; in this course this nerve is covered superiorly by the glutæus maximus and the hamstrings, inferiorly by the fascia lata and the integuments; the sciatic nerve sends off several cutaneous and muscular branches, the latter supply the hamstrings, the gracilis, and the adductor magnus. The *external popliteal* or the *peronæl nerve* descends obliquely outwards along with the biceps tendon to the external condyle of the femur, it then turns forwards through the peronæus longus, round the neck of the fibula, and divides into two branches, the musculo-cutaneous and anterior tibial; the peronæal nerve, before it arrives at the head of the fibula, sends off two or three long branches, termed the external cutaneous nerves of the leg; these descend along the outer and back part of the leg, and communicate with the external saphenus nerve a branch of the posterior tibial. The musculo-cutaneous nerve descends between the peronæus longus and extensor digitorum longus; to these and to the short peronæi muscles it sends several muscular branches; about the middle of the leg, it perforates the fascia, and a little above the outer malleolus it divides into the internal and external tarsal nerves or dorsal nerves of the foot; the internal is distributed to the integuments of the first and second toes, and communicates with the internal saphenus nerve and with the anterior tibial; the external supplies the integuments on the three outer toes, and communicates with the internal branch and with the external saphenus nerve. The *anterior tibial nerve* descends obliquely forwards along with the anterior tibial artery between the tibialis anticus and the extensor digitorum longus and extensor pollicis, which muscles it supplies; it also sends branches through the fascia to the integuments; it then passes beneath the annular ligament of the tarsus, and runs to the inter-osseous muscle between the first two metatarsal bones; on the foot it sends a large branch to the extensor digitorum brevis, also several cutaneous and communicating filaments, and it terminates by supplying the first interosseal muscle and the integuments of the two internal toes; in the first interosseal space a small branch communicates with the plantar nerves. The *internal popliteal* or *posterior tibial nerve* is larger than the preceding; it descends nearly vertically between the heads of the gastrocnemius and solæus muscles, and behind the articulation of the knee and the poplitæus muscle; it then descends obliquely inwards beneath the solæus and on the tibialis posticus and flexor digitorum longus, to the arch beneath the heel and the internal ankle; it here divides into the internal and external plantar nerves. In the ham a quantity of fat separates this nerve from the popliteal vessels; below the knee it becomes more closely connected to them, lying superficial and a little to their inner or tibial side; at the lower edge of the poplitæus it passes to the outer or fibular side of the posterior tibial artery and descends in that relation to this vessel as far as the internal malleolar region. The posterior tibial nerve above the knee gives off a small nerve, the posterior or external saphenus; this descends along the back of the leg, at first covered by the fascia, afterwards it is subcutaneous; it communicates superiorly with filaments from the cutaneous branch of the sciatic plexus and with the external cutaneous branches of the peronæal nerve; about the

middle of the leg it is increased in size, and accompanies the external saphena vein to the external malleolus, behind which it passes; it then curves forwards along the outer edge of the foot, communicating with the external dorsal nerves of the foot and supplying the integuments and muscles on the outer side of this region. In the ham, the posterior tibial nerve gives off several very large muscular branches to the gastrocnemius, solæus, and plantaris; and in its course down the leg several smaller branches to the deep-seated muscles; it also sends numerous filaments around the artery; some very small twigs pass through the inter-osseous space along with the anterior tibial artery and join the anterior tibial nerve. The *internal plantar nerve* is larger than the external; it passes forwards along the inner side of the tarsus above the abductor pollicis, sends many branches to the plantar muscles and to the integuments, and arriving near the base of the great toe, divides into four digital branches; the first runs along the tibial side of the first toe: the second subdivides and supplies the opposed sides of the first and second toes; the third, in like manner, the second and third toes; and the fourth the opposed sides of the third and fourth toes: these digital nerves also supply the lumbricales, and communicate with the dorsal nerves of the foot. The *external plantar nerve* passes forwards and outwards above the flexor brevis to the fifth metatarsal bone, and divides into two branches; one, the superficial, supplies the little toe and the outer side of the fourth; the deep branch passes obliquely inwards across the metatarsus, and supplies the inter-ossei and the other deep plantar muscles.

§ 3.—*Dissection of the Ganglions.*

In addition to the small ganglions already noticed in the description of the cerebral nerves, viz. the lenticular or opthalmic, the spheno-palatine, or Meckel's, and the sub-maxillary, also the several ganglions on the spinal nerves, we find one continued chain of these bodies placed anterior to the vertebral column on either side of the median line; these ganglions, on each side, are all connected to each other, and resemble a knotted cord; this cord receives the name of the sympathetic nerve.

The Sympathetic Nerves, therefore, are two in number; they descend from the base of the cranium perpendicularly along the neck, placed on the rectus capitis and longus colli muscles, and behind the great vessels and nerves; at the upper part of the chest each of these nerves is divided by the subclavian artery into several branches, which encircle that vessel and unite below it in the thorax; through this cavity they descend at first obliquely backwards and outwards along the heads of the ribs and covered by the pleura; they then incline a little forwards and pass behind the true ligamentum arcuatum into the abdomen; through this region they descend obliquely outwards on the fore-part of the lumbar vertebræ and between the psoas and the crus of the diaphragm; they then sink into the pelvis, keeping close to the sacrum, and descend along the anterior surface of this bone obliquely inwards: near its inferior extremity, or on the first part of the coccyx, these nerves unite and terminate in a small ganglion named ganglion impar. The superior extremity of each sympathetic nerve is connected by several filaments to several of the cerebral nerves; some of these connections

have been improperly termed the origin of the sympathetic; in their course along the spinal column each nerve regularly communicates with every pair of the spinal nerves, with each of the cervical nerves by one filament, and with each of the dorsal, lumbar, and sacral nerves by two; the sympathetic nerves may either be considered as independent parts of the nervous system communicating by numerous branches with every portion of that system, or they may each be regarded as a nervous cord formed by the union of branches from all the spinal and from several of the cerebral nerves; the latter is probably the more correct view. The sympathetic nerves send off numerous branches, which are chiefly destined to supply the heart and the coats of the great vessels and all the pelvic and abdominal viscera except the stomach; these branches arise from the ganglions on these nerves; of these there are generally three in the neck; in the back and loins they correspond with the number of vertebræ in those regions, and in the pelvis there are three on each side and the coccygeal or impar ganglion below; these ganglions and their branches must be next examined.

The *cervical ganglions* are three, the superior, middle, and inferior; the *superior cervical ganglion* is of an oval figure and reddish color, extending from the first to the third cervical vertebra, placed on the rectus capitis anticus, behind the carotid artery and jugular vein, and internal to the eighth and ninth cerebral nerves: this ganglion sends off several branches, viz. superior, inferior, internal, external, and anterior; the superior branches are two in number; they ascend in the carotid canal to the cavernous sinus, and communicate with the sixth, and with the vidian branch of the fifth; in this situation a plexus and sometimes a ganglion may be observed on the external surface of the artery, fine soft reddish filaments pass from this to the several nerves which are about to enter the orbit through the foramen lacerum, also to the gasserian ganglion of the fifth, and several continue attached to the carotid artery, and are lost in its cerebral branches. The inferior or descending branches of the superior ganglion are small filaments to join the laryngeal nerves and the vagus, the superior cardiac nerve, (to be described presently,) and the continued cord of the sympathetic itself. The internal branches unite with the pharyngeal plexus; the external join the superior cervical nerves, and the anterior unite with branches of the vagus and facial, and form a plexus around the carotid artery; from this several branches extend along the external carotid, and form plexuses around each of its principal branches, which are named accordingly. The *middle cervical ganglion* is sometimes wanting; it is smaller than the superior, of a triangular, often an irregular form, is situated behind the carotid near the curve of the inferior thyroid artery, opposite the fifth vertebra, and upon the longus colli muscle; it sends off branches in different directions which communicate with the cervical nerves and with the vagus; it also sends some filaments to join the cardiac nerves. The *inferior cervical ganglion* is of an irregular figure; it frequently appears to consist of several small ganglions connected to each other by reddish filaments; it is situated between the transverse process of the last cervical vertebra and the neck of the first rib, behind and on either side of the vertebral artery, and between the scalenus and longus colli muscles; filaments from it communicate with the phrenic nerve and with the brachial plexus; several also encircle the subclavian artery and extend along that trunk and its several

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branches, particularly along the vertebral artery; from it also the inferior cardiac nerves proceed. The student may next examine the *cardaic nerves;* there are three on each side, they are named superior, middle, and inferior; the *superior* cardiac nerve, though very small, takes a long course; it arises by two or three filaments from the superior cervical ganglion, descends along the side of the trachea behind the carotid artery to the chest; in this course, it communicates with the laryngeal nerves, with the vagus, and with the inferior and middle ganglions of the sympathetic; there is sometimes a small ganglion upon it near the inferior thyroid artery; at the lower part of the neck it passes behind the subclavian vein and over the arteria innominata; it here divides into several filaments; some pass along the coats of that vessel to the aorta, others join the recurrent nerve and the middle and inferior cardiac nerves; the superior cardiac nerve on the left side has a similar origin and course in the neck, but it enters the chest in a deeper situation than the nerve of the right side; it descends between the left carotid and subclavian arteries, and arriving at the arch of the aorta, divides into branches, some of which pass behind that vessel and join the cardiac ganglion; others unite with the cardiac nerves from the sympathetic, or from the vagus and recurrent. The *middle* cardiac nerve on the right side is generally the largest of the cardiac nerves; on the left side it is sometimes wanting, the inferior in such a case will be of a greater size; it arises by several filaments from the middle cervical ganglion or from the sympathetic nerve about the middle of the neck; it descends either a single cord, or divided into several parallel filaments behind and internal to the carotid, and enters the thorax anterior to the subclavian artery; it here is joined by large branches from the vagus and recurrent nerves, it then descends obliquely inwards along the side of the arteria innominata, glides between the arch of the aorta and the division of the trachea, and terminates in the cardiac ganglion or plexus. On the left side the middle cardiac nerve sometimes arises from the inferior cervical ganglion; it enters the chest along the subclavian artery, and either joins the inferior cardiac nerve or enters the cardiac plexus. The *inferior* cardiac nerve or nerves proceed from the inferior cervical ganglion, and on the right side descend along the arteria innominata to the arch of the aorta, round which they pass to its fore-part, and terminate principally in the anterior cardiac plexus; some branches pass between the aorta and pulmonary artery to the cardiac ganglion; these inferior cardiac nerves communicate with the preceding, and with the vagus and its recurrent; they form an irregular network or plexus in their course to the aorta; on the left side these nerves accompany the subclavian artery and partly join the middle cardiac nerve, and partly the cardiac plexus. The *cardiac plexus* or *cardiac ganglion* is situated behind the ascending aorta near its origin, and in front of the trachea and of the right pulmonary artery; of a grayish color and irregular form, it consists of a plexus of nerves formed by the cardiac nerves from opposite sides, also by branches of the eighth pair and the recurrent nerves; in the meshes of this plexus several small ganglions are enclosed, and to the aggregate of these the term cardiac ganglion is applied; superiorly it receives the middle cardiac nerves from each side, also some filaments from the superior cardiac, particularly on the left side, and also some from the inferior cardiac, particularly on the right side; the greater portion of the right superior cardiac joins the middle

cardiac before tne latter arrives at the plexus, and the inferior is chiefly distributed on the fore-part of the aorta to the anterior cardiac plexus: from the great cardiac plexus branches proceed in various directions, some pass backwards encircling the posterior coronary artery, and forming a plexus around it, and accompanying its branches into the substance of the heart, others pass forwards round the aorta, form the anterior cardiac plexus on it and on the right pulmonary artery, and vena cava; from this plexus branches descend over the right auricle, accompanying the anterior coronary artery, and form plexuses around it and its several branches; from this ganglion also numerous nerves descend on either side along the pulmonary vessels and communicate with the pulmonary plexus; on the left side these branches encircle the ductus anteriosus.

The sympathetic nerves in the thorax have twelve ganglions on each side, sometimes only eleven, the last cervical and first dorsal being then united; each of the *thoracic ganglions* is small and triangular, the base towards the spine, the apex externally; covered by the pleura and placed on the heads of the ribs, the first ganglion is the largest; they all communicate by one or two branches, which ascend obliquely outwards, with the anterior or intercostal branch of the spinal nerves; from the base or anterior edge of each ganglion small branches pass forwards to the mediastinum, ramify on the aorta and adjacent vessels, and communicate with the pulmonary plexus. From the six inferior ganglions the splanchnic nerves arise; these are two in number on each side, the greater and lesser or superior and inferior. The *great splanchnic nerve* arises by distinct roots from the sixth, seventh, eighth, ninth, and tenth ganglions, these descend obliquely forwards and unite on the tenth dorsal vertebra into one cord, which enters the abdomen either along with the aorta or separated from it by a fasciculus of the diaphragm; each nerve then expands into the semilunar ganglion. The *lesser splanchnic nerve* arises by two roots from the tenth and eleventh ganglions; these unite on the side of the last dorsal vertebra; this small nerve then enters the abdomen through the crus of the diaphragm, communicates with the preceding, and ends in the renal plexus. In the abdomen we find the semilunar and the lumbar ganglions of each side; the *semilunar* ganglion of each side is situated on the diaphragm, and partly on the aorta on either side of the cœliac axis, and above and behind the supra-renal capsule; these are the largest ganglions on the sympathetic; they communicate with each other by several filaments on which small ganglions are placed; this communication surrounds the cœliac axis, and is termed the *solar plexus;* this plexus is situated behind the stomach, in front of the aorta and above the pancreas; from it numerous nerves pass off in various directions; these nerves accompany the blood vessels, and form plexuses around each, which are named according to their destination, hepatic, splenic, and gastric; these plexuses communicate with the eighth pair; from the solar plexus branches descend in front of the aorta; these subdivide at the renal and mesenteric arteries, accompany these vessels, form plexuses around each, which are named accordingly the renal, superior, and inferior mesenteric plexuses, into each of these, branches from the lumbar ganglions enter. The lesser splanchnic nerve enters the renal plexus; from each renal plexus descends the spermatic plexus, which in the male descends in the spermatic cord and supplies the testicle; in the female it enters the pelvis and supplies

the ovarium and uterus. From the inferior mesenteric plexus branches descend to the edge of the pelvis, unite with others from the lumbar ganglions, and form a plexus around the internal iliac artery and its pelvic branches; this is termed the hypogastric plexus: it is joined by numerous filaments from the lumbar and sacral ganglions of the sympathetic, and it communicates with the pelvic branches of the sacral plexus. The *lumbar ganglions* of the sympathetic are five on each side, sometimes only four or three; they are situated on the anterior and lateral parts of the bodies of the vertebræ internal to the psoas, of an oval figure, smaller than the cervical; each ganglion is connected by one or two communicating branches which pass through the psoas to the anterior branches of the lumbar spinal nerves; from the fore-part of each several filaments pass in front of the aorta and assist in the formation of the different abdominal plexuses which are principally derived from the solar plexus. The *sacral ganglions* are three or four in number; the first is oval, the remaining are of an irregular form; they each communicate with the sacral nerves and send filaments to the hypogastric and pelvic plexuses; from the last ganglion on each side a small branch passes inwards in front of the coccyx; these branches unite in the middle line and form a small plexus, sometimes a distinct ganglion is placed here; from the convexity of the arch which these branches form, filaments pass off to the coccygæus, levator, and sphincter ani muscles.

CHAPTER. IV.

ORGANS OF SENSE.

Under this head may be placed the anatomy of the nose, or the organ of smell; the tongue, or the organ of taste; the eye, or the organ of vision: and the ear or the organ of hearing; to these may be added the integuments or the organ of touch.

§ 1.—*Anatomy of the Nose.*

Several bones enter into the formation of this organ; these are all lined by a highly sensible mucous membrane; to the anterior part of the bones of the nose, the cartilages, which form the septum and alæ nasi, are attached. The nose is bounded superiorly by the nasal, frontal, ethmoid and sphenoid bones, the roof of the nose is arched, and has different aspects, the anterior part looks downwards and backwards, the middle perpendicularly downwards, and the posterior part downwards and forwards; inferiorly by the palatine plates of the maxillary and palate bones, the floor of the nose is nearly horizontal, but with a slight inclination backwards, and is concave in the transverse direction, on either side by the superior maxillary, unguis, spongy, ethmoid and palate bones, and by the internal pterygoid plates; it is divided into two symmetrical portions (the nares) by the septum, which is composed of the azygos plate of the sphenoid, the nasal lamella of the ethmoid, the vomer, the spines of the palate and maxillary bones, and by a cartilage; the external wall of each naris

is deeply groved by three fossæ or meatuses, the superior, middle, and inferior; they are situated between the spongy bones, the middle is the widest; the nasal or lachrymal duct opens into the anterior third of the inferior meatus, the Eustachian tube behind, but on a level with the inferior spongy bone, and at the side of the septum anteriorly may be observed the superior orifice of the anterior palatine canal, which, although a distinct opening superiorly towards the cavity of the nose, yet inferiorly towards the mouth, forms with the one of the opposite side a common foramen; this communication, however, between the nose and mouth does not exist in the recent state in the human subject, but does so in some animals, and in these Jacobson has ascribed a peculiar office to it; into the middle meatus, the antrum maxillare opens by a small oblique slit, which looks backwards and inwards, and although in the dry bone appears tolerably large, yet in the recent state admits only a small probe, on account of the mucous membrane being thrown into a small fold which surrounds it, and in front of this, a groove, named the infundibulum, which leads from the frontal sinus; into this groove the anterior ethmoid cells open; into the upper meatus, the posterior ethmoid cells and the sphenoid sinus open; each naris opens posteriorly into the pharynx, above the velum, by an oblong oval opening; these are separated from each other by the vomer, the internal pterygoid plates bound them externally, the sphenoid above and the palate bones below. To the anterior edge of each naris the cartilages composing the alæ nasi are attached, these are five in number, one in the centre, two at each side; the central cartilage is triangular and vertical, attached superiorly and posteriorly to the bony septum, its anterior edge is thick and sub-cutaneous, and attached on either side to the lateral cartilages; the lateral cartilages are two, one superior and triangular, attached to bone, the other inferior, and irregularly curved, convex externally, and attached to the preceding and to the septum; in the alæ nasi small pieces of cartilage also may be noticed distinct from the larger cartilages. All the internal surface of the nose and of the sinuses communicating with it, are lined by a soft, vascular, and highly sensible mucous membrane; this is the *pituitary* or *Schneiderian membrane;* this mucous membrane is continuous anteriorly with the integuments; it adheres to all the internal surface of the bones of the nose, lines the sinuses, is continuous through the nasal duct with the membrana conjunctiva of each orbit; round the lower extremity of each duct it forms a slight circular fold; and posteriorly it is continuous with the membrane of the pharynx and Eustachian tubes; this membrane adheres inseparably to the periosteum; it is villous, very vascular, soft and thick on the septum and turbinated bones; at the extremities of the latter it forms thick fleshy-looking folds or lips; in the sinuses it is pale and thin; it is constantly moistened with a mucous secretion; mucous glands are not distinct in it; the olfactory or first pair of nerves are distributed to it in the form of numerous plexuses, it is also supplied with branches from the opthalmic and superior maxillary divisions of the 5th pair; the first pair are generally believed to endow the membrane with the peculiar sensibility of smelling; Magendie, however, has recently made some experiments to prove that the branches of the 5th pair are accessory to this function.

§ 2.—*Organ of Taste.*

The organ *of taste* resides in the mucous membrane of the tongue; this membrane is spread over the muscular substance of the tongue, adheres closely to it, and presents a number of projections or papillæ; the tongue is very vascular and is supplied with six nerves; the gustatory is distributed anteriorly and chiefly to the papillæ, the lingual to the inferior surface and to its muscular substance the glosso-pharnygeal to the muscular substance and mucous membrane at its base; experiments have proved that the 5th nerve endows this organ with its peculiar sense, that of taste; and that the lingual or 9th is its motor nerve; the glosso-pharyngeal is probably for the purpose of connecting the tongue in sympathy with the stomach and the respiratory organs; the form of the tongue has been already described, (see page 22.)

§ 3.—*Anatomy of the Ear.*

The parts composing this complicated organ may be divided into three classes; the 1st concludes the external ear, or the cartilages and meatus externus; the 2d the tympanum with the Eustachian tube, ossicula auditus and mastoid cells; the 3d the labyrinth or internal ear, which includes the vestibule, semicircular canals, cochlea, and meatus internus with the portio mollis.

The *external ear* consists of the pinna or auricle and the meatus externus; the *pinna* is composed of a thin fibro-cartilaginous plate, curved in different directions, so as to present different eminences and depressions; the convex edge which forms the outline of it is the *helix,* below this is a short semicircular fold, the *anti-helix,* this divides superiorly into two crura; the depression between these is the *fossa navicularis*; in front of the meatus is an eminence, the *tragus,* directed backwards over the meatus; opposite to this is a slight projection, the *anti-tragus*; within these several eminences is a deep conical cavity, the *concha* which leads to the meatus externus, below this, is the pendulous fold of the integuments, or the *lobe* of the ear; these several eminences are supposed to be of use in protecting the internal parts, also in collecting and directing the sound towards the matus; in some subjects pale muscular fibres may be found on these eminences, they have been named according to their situation, as distinct muscles, tragicus, anti-tragicus, major and minor helicis, and transversalis auris; these fibres may have some power in approximating these cartilages, and thus deepening the concha, they are seldom marked in the human subject, but in the lower classes of animals they are strong and distinct. The *meatus auditorius externus* extends from the concha to the membrana tympani, first forwards, upwards, and inwards, then downwards and inwards; it is therefore curved, or concave downwards, about an inch in length, one half cartilaginous, the other osseous; it is lined by skin, beneath which are a number of ceruminous glands, the cuticle is continued over the membrana tympani, from which it readily separates, and is furnished with a number of fine hairs, which are longer and more obvious externally.

The *middle ear* consists of the tympanum and its appendages. The *membrane tympani* separates this cavity from the meatus externus, the latter must be cut vertically to expose this membrane; it is placed obliquely, its lower

edge being more internal than the upper, or nearer the median line, it therefore looks downwards, outwards, and forwards; it is concave towards the meatus, convex towards the tympanum, being drawn in the latter direction by its connection to the handle of the malleus; it consists of three layers, an external or cuticular, an internal or mucous, and a middle or fibrous, which is dry and elastic. The *cavity of the tympanum* may be seen either by dividing the membrane just described, or, without injuring the latter, the roof of the cavity may be broken or cut through at the lower and internal part of the squamous plate; this cavity is placed between the meatus externus and the labyrinth; it is of an irregular figure, rather circular; it presents on its internal side a tubercular eminence, named the *promontory*, and two foramina, one above, the other below that eminence; the superior foramen or *fenestra ovalis*, is closed by a membrane, to which the base of the stapes bone is attached, this opening communicates with the vestibule; the inferior or the *foramen rotundum* is also closed by a membrane, it communicates with the internal part of the cochlea or the scala tympani; the posterior wall of the tympanum presents superiorly the opening of a short canal, which leads to the mastoid cells, these are of irregular form and differ in different subjects; beneath this is the *pyramid*, a small bony projection, hollow, containing the muscle of the stapes; beneath the pyramid is the small foramen leading from the aqueduct of Fallopius, and transmitting the corda tympani. The tympanum presents anteriorly the openings of two canals, one superior containing the tensor tympani muscle, the other, the inferior, is the *Eustachian tube*; this descends obliquely forwards and inwards, and terminates by a trumpet-shaped mouth, behind the posterior nares, on a level with the inferior spongy bone; this canal is small, and osseous posteriorly, anteriorily it is large and formed of membrane externally, and of a curved fibro-cartilage internally; it is lined by mucous membrane, which is prolonged from the pharynx into the tympanum; through this tube the atmosphere can pass from the fauces into the tympanum, to support the latter on its internal surface. In the superior boundary of the tympanum are some small foramina for the passage of blood-vessels; its inferior boundary presents the glenoid fissure, through which pass the corda tympani, the tendon of the laxator tympani, and the processus gracilis of the malleus. Within the cavity of the tympanum are four small bones, first the malleus, attached to the membrana tympani, and resting on the second, the incus, one leg of which is connected to the third, the orbicular, which is articular to the fourth, the stapes, which rests on the membrane of the fenestra ovalis, between which and the membrana tympani these four bones form a connecting chain, for the purpose of conveying the impression of sound from the membrana tympani to the internal ear. The *malleus* is immediately behind the membrana tympani, it presents a head, neck, handle, a long and short process; the head is smooth and articulated behind with the incus, the neck is small, and gives origin anteriorly to the processus gracilis, which is about half an inch long, traverses the glenoid fissure, and gives attachment to the tendon of the laxator tympani muscle; the handle descends from the neck, adheres to the membrana tympani, and has a short process superiorly for the insertion of the tensor tympani muscle. The *incus* is internal and posterior to the malleus, presents a body, and a long and short crus; the body is directed forwards and upwards, and receives the head of the malleus, the superior crus is short, and lies in the foramen of the

mastoid cells, the inferior long, and perpendicular, is articulated with the following: The *os orbiculare,* extremely small, is between the incus and the following: The *stapes* is placed horizontally, the base is on the fenestra ovalis, the head is articulated to the orbicular bone, the neck gives attachment to the stapedius muscle, the crura of the stirrup are separated by a space filled by membrane.

There are three muscles in the tympanum, viz. stapedius, tensor, and laxator tympani. *Stapedius arises* within the pyramid; its tendon is *inserted* into the neck of the stapes; its *use* is to raise the stapes, and to press its base against the fenestra ovalis. *Tensor tympani arises* in the canal in the petrous bone above the Eustachian tube, passes backwards into the tympanum, and is *inserted* into the short process below the neck of the malleus; *use* to draw the malleus into the tympanum, and thus to increase the concavity of the membrana tympani. *Laxator tympani arises* from the spinous process of the sphenoid bone, and from the Eustachian tube, ends in a delicate tendon which passes through the glenoid fissure along with the cordi tympani, and is *inserted* into the processus gracilis of the malleus or the process of Raw. *Use,* to draw the malleus forwards, and thus to relax the membrana tympani.

The *labrynth,* or the *internal ear,* consists of the vestibulum, cochlea, semicircular canals, and meatus internus. *Vestibulum* is a small elliptical cavity behind the cochlea and in front of the semicircular canals, the fenestra ovalis opens on its external side, the five orifices of the semicircular canals open superiorly and posteriorly, one opening from the cochlea is anteriorly, and posteriorly is the orifice of a small canal called the aqueduct of the vestibule. A delicate but vascular membrane lines this cavity; it is filled by a peculiar fluid, and extends into the aqueduct of the vestibule. The *semicircular canals* are three in number, superior, posterior, and horizontal; the two first are vertical; they are surrounded by the petrous bone in front of the mastoid cells and behind the vestibule; the superior and posterior are joined by one end; there are, therefore, but five orifices of these canals in the vestibule; each of these tubes is lined by a vascular membrane filled with a fluid which communicates with that in the vestibule. The *cochlea* is in the anterior part of the petrous bone, it is somewhat conical, the base towards the meatus internus, the apex towards the carotid artery; the cochlea, internally, consists of a central pillar placed somewhat horizontally, named the modiolus, and of a spiral tube passing round this axis two turns and a half; this tube is divided into two by a thin osseous and membranous plate, called lamina spiralis, and the two tubes are the scalæ of the cochlea; near the apex of the cochlea these scalæ communicate; near the base they separate; one, the scala vestibuli, communicates with the vestibule; the other, the scala tympani, with the tympanum through the fenestra rotunda; the modiolus is hollow and expanded towards the apex; this expansion is called the infundibulum; a branch of the auditory nerve passes through this cavity; the aqueduct of the cochlea terminates in a small slit-like opening in the petrous bone just below the meatus auditorius internus. The *portio mollis* of the seventh pair of nerves descends along the meatus auditorius internus, divides into several fine branches which are distributed to the membrane lining the vestibule, cochlea, and semicircular canals.

§ 4.—*Anatomy of the Eye.*

Under this head we shall examine not only the globe of the eye but its appendages; these are the eye-lids, the lachrymal apparatus, and the muscles of the orbit.

The muscles of the orbit are seven in number, viz. the levator palpebræ superioris, the obliquus superior and inferior, and the four recti; to obtain a satisfactory view of these muscles, the roof and a considerable portion of the external side of the orbit must be removed; then the periosteum having been divided, the first muscle appears.

Levator Palpebræ Superioris is the highest muscle in the orbit; it *arises* narrow and tendinous from the upper edge of the foramen opticum, passes forwards and outwards beneath the frontal nerve, and becoming broader, bends down in front of the eye; it then ends in a dense cellular expansion which is *inserted* into the superior border of the tarsal cartilage and into the superior palpebral sinus of the conjunctiva behind the palpebral ligament. *Use*, to elevate and retract into the orbit the upper eye-lid.

Obliquus Superior, at the upper and inner part of the orbit, *arises* on the inner side of the preceding, passes forwards along the os planum, ends in a round tendon which plays through the fibro-cartilaginous pulley which is attached to the inner angle of the os frontis; this tendon is then reflected backwards, outwards, and downwards, between the superior rectus and the eye, and then becoming broad and thin, is *inserted* into the sclerotic coat between the superior and external recti, about midway beween the entrance of the nerve and the insertion of the superior rectus. *Use*, to draw the eye forwards and inwards, also to rotate it, so as to direct the cornea downwards and inwards towards the tip of the nose. Some authors consider it a rotator outwards.

Obliquus Inferior is situated at the inferior and anterior part of the orbit; it *arises* tendinous from the orbital edge of the superior maxillary bone above the infra-orbital foramen, and external to the lachrymal sac; it *ascends* obliquely outwards and backwards below the inferior rectus, and is *inserted* by a tendinous expansion into the sclerotic coat behind the transverse axis of the eye, and between the sclerotic coat and the external rectus. *Use*, to draw the globe forwards and inwards, and to rotate it upwards and outwards.

Recti muscles are four in number, the superior is called *attollens oculi*, the inferior *depressor oculi*, the internal *adductor*, and the external *abductor oculi*; they all *arise* around the optic foramen; the external has an additional attachment to the foramen lacerum; they all pass forwards around the optic nerve, separated from it by the ciliary vessels and nerves, and by a great quantity of fat; a little beyond the middle of the eye they become tendinous, and are each *inserted* about a quarter of an inch behind the cornea; the four tendons are connected together by an aponeurosis which is attached to the conjunctiva; the *use* of these muscles is, collectively, to retract the eye into the orbit, and individually to move it, as their names imply.

Under the head of lachrymal apparatus we may consider the lachrymal gland, membrana conjunctiva, palpebræ, and lachrymal passages. The *lachrymal gland* is placed in the upper part of the orbit, behind the external

angular process of the os frontis, above the external rectus and the conjunctiva; of a flattened oval figure, and a pale color, separable into two or more lobes, which, like other conglomerate glands, can be separated into numerous granules; these are united by a loose capsule; from these, five or six small ducts proceed and open behind the upper eye-lid along the line of reflection of the conjunctiva from the palpebra to the sclerotic.

The *membrana conjunctiva* is a mucous membrane lining each palpebra, and continuous at their margin with the integuments; it also covers the anterior part of the globe; near the inner canthus it is thrown into a semilunar fold, and is continued through the puncta lachrymalia into the nasal sac and duct, and becomes continuous with the mucous membrane of the nose. This membrane is more vascular on the palpebræ and caruncula than on the surface of the eye: it is loosely connected to the sclerotic coat to within half an inch of the cornea; it then becomes so delicate and so adherent that it is difficult to separate it further, and although it is generally described as being continued over the cornea, it is impossible to dissect it from it unless previously macerated or changed by disease; at the inner canthus of the orbit it is thrown forwards by a fleshy looking tubercle of a conical figure, the *caruncula lachrymalis*; this is composed of a few mucous follicles and the bulbs of some fine hairs that project from its surface. The conjunctiva is a secreting, and according to some, an absorbing surface; it is constantly moistened by the fluid it secretes, and occasionally by the lachrymal secretion; it serves, as its name implies, to join the eye-lids to the eye, to facilitate the motions of the former, and thereby to clear the surface of the latter; it also closes the orbit against any extraneous substance, and serves to support and confine the eye-ball in its several motions.

Palpebræ are composed of the skin, the orbicular muscle, a thin cartilage connected to the base of the orbit by a cellulo-ligamentous connection, and lined by conjunctiva; in the superior there is also the expansion of the levator palpebræ muscle; the upper is larger than the lower eye-lid, therefore when they are closed the former descends below the transverse axis of the eye, and the inferior ascends but little to meet it; they are both concave posteriorly, adapted to the surface of the eye, their margins are thick, and furnished anteriorly with the eye-lashes, posteriorly with numerous mucous follicles; their opposed edges are sloped off obliquely towards the eye, so that when the lids are closed a sort of triangular canal is formed, the base of which is the surface of the eye; along this canal the tears are supposed by some to be directed inwards towards the puncta, others however deny that any such space can exist, and affirm that the lachrymal secretion flows along each palpebral sinus, and is directed inwards by the action of the orbicular muscle; the skin of each palpebra is thin, the sub-cutaneous cellular tissue very loose and reticular; beneath this the orbicular muscle is expanded.—(See page 3.) The *tarsal cartilages* are thin elastic plates; the superior is semilunar and larger than the inferior, which is long and narrow; the ciliary margins are thick; their orbital edges thin and connected to the orbit by the palpebral ligaments which are a continuation of the periosteum; these ligaments are stronger towards the temple, where they decussate and attach the cartilages at their external canthus or commissure; the tendo oculi fixes them internally. Between each tarsal cartilage and the conjunctiva are the *Meibomian*

gland or *follicles*; they are of a white or yellow color, are arranged in nearly parallel vertical rows, and are more numerous in the upper eye-lid; they secrete a thin sebaceous fluid, which is discharged by a row of small holes along the edge of each tarsus behind the ciliæ. The *ciliæ* arises from bulbs which are beneath the skin; those of the upper eye-lid are more numerous than those in the lower; both are curved, convex towards each other.

The *Puncta Lachrymalia* are two small holes always open, directed backwards and outwards, opposite each other; they meet when the lids are closed; each is situated in a little cartilaginous projection, about two lines from the inner canthus; each is the orifice of a small duct.

The *Lachrymal ducts* extend from the puncta to the lachrymal sac; the superior is longer and more curved than the inferior; the former is concave inferiorly; the latter is nearly straight, a little concave upwards; they both open into the external part of the sac, a little above its middle, sometimes by one, and sometimes by distinct orifices, behind the tendo oculi; each duct is surrounded by a process of that tendon, and lined by mucous membrane.

The *Lachrymal sac* is a small oval pouch of mucous membrane, closed above and leading below into the nasal duct, it is situated in a fossa formed by the maxillary and unguis bones, covered by the integuments, the tendon and some fleshy fibres of the orbicularis muscle, also by a strong fascia which is derived from that tendon and connected to the surrounding bony margin. A small muscle has been described by Mr. Horner as *arising* from the edge of the os unguis, and *inserted* into the lachrymal sac and ducts; he conceives it to have the power of compressing the sac, and directing the ducts and their contents towards it; it is not however in all subjects to be distinguished from the orbicular, which last can effect the purpose ascribed to this small muscle.

The *Nasal Duct* (about three-fourths of an inch in length in the recent state) descends from the sac obliquely backwards and a little outwards surrounded by the maxillary, unguis, and inferior spongy bones; beneath the latter it opens by a small slit-like orifice, which is surrounded by a circular fold of mucous membrane, into the lower meatus, about an inch from the anterior part of the naris; this duct is formed of mucous membrane only, it is connected to the periosteum. The nerves and vessels of the orbit have been already examined. The nerves of the palpebræ are derived from the portio dura of the 7th, from the lachrymal, frontal, and nasal branches of the opthalmic, and from the infra-orbital branches of the 5th pair of nerves; the vessels are branches of the opthalmic, temporal, and facial.

DISSECTION OF THE GLOBE OF THE EYE.

It will facilitate the student in learning the anatomy of the eye, to dissect this organ in some of the inferior animals; almost every part of importance may be examined with equal advantage in the eye of the sheep, ox, or pig, as in that of the human subject; many of the minute parts are even on a larger scale, and can be dissected with greater ease: we also have it in our power in general to dissect the eyes of the inferior animals in a perfectly fresh state.

The eye is situated at the anterior and internal part of the orbit, behind the

conjunctiva, surrounded by muscles and fat, and connected posteriorly by the optic nerve; the axes of the eyes are parallel to each other, therefore not so to those of the orbits; each eye is nearly spherical; the antero-posterior axis, which is nearly an inch, being about one or two lines greater than the transverse or vertical axis; the cornea, which is a segment of a smaller sphere, and which forms about the anterior fifth of the globe, being superadded to the larger sphere, formed by the sclerotic; this spherical form favors the motion of the eye-ball. The eye is composed of fluids or humors enclosed in different tunics; the latter are the sclerotic, choroid and retina; the first is a fibrous, the second a vascular, and the third a nervous coat; the humors are the aqueous crystaline and vitreous; these are also enclosed in distinct capsules.

Tunica Sclerotica is a dense, opaque, fibrous membrane, extending from the optic nerve to the cornea; the nerve perforates it about a line internal to its centre by a small conical aperture, which appears traversed by fibres, so as to present a cribriform appearance; it is doubtful however, whether this indistinct appearance may not partly depend on the central vein and artery of the retina which accompany the nerve through this opening; the sheath of the optic nerve is continuous with the fibres of this membrane; the external surface is rough and perforated by several holes; anteriorly it receives the cornea, and is so intimately connected to it, that maceration alone can separate them; both are sloped off obliquely as well as slightly grooved; the sclerotic overlaps the cornea; their connection is still further secured by the conjunctiva externally, and by the membrane of the aqueous humor internally; a vertical section of this tunic from behind forwards will show its great thickness near the optic nerve, and its thinness in the centre; anteriorly it is again strengthened by the tendinous expansion of the recti muscles; this expansion has been improperly called the tunica albuginea; the sclerotic consists of fibres which run in every direction, but which do not form distinct laminæ; its internal surface is smooth and glistening; the ciliary vessels and nerves run between it and the choroid; from this surface a fine serous-like lamina* may be raised; this is reflected on the choroid coat.

The *Cornea* forms the anterior fifth of the eye; it is nearly circular, its transverse diameter being a little greater than its vertical; it is very smooth and transparent, of a laminated, not a fibrous texture; some fine cellular tissue connects the laminæ to each other; the cornea is more thick and pulpy in the child than in the adult; it is covered anteriorly by a fine and closely adhering membrane, which though generally considered a continuation of the conjunctiva, is very different from it in its structure and properties; the concave surface of the cornea is lined by a fine elastic membrane, which is described by some as a part of the membrane of the aqueous humor; it is, however, a membrane sui generis; it is best seen in the eye of a horse, which has been macerated for some days, the external laminæ, which are now opaque, can be peeled off, leaving behind it this elastic cornea, which preserves its proper curve and transparency, if it be cut it will curl upon itself, thus exhibiting true elastic cartilaginous properties. Fix the eye in a small shallow vessel, which can be immersed occasionally under water, carefully raise a

* This is the continuation of the tunica arachnoidea, which accompanies the optic nerve from the brain.

small portion of the sclerotic, pass in some air between it and the choroid, these membranes can thus be easily separated; then dissect off the sclerotic, this tunic can be readily detached as far as the cornea, here it adheres to the ciliary ligament; this connection may be separated with the handle of the knife, the cornea, or one half of it, may also be removed with the sclerotic and the next tunic of the eye will be exposed, the choroid, with its appendages, the ciliary ligament, ciliary processes, and iris.

The *Choroid coat* extends from the optic nerve all round the eye, between the sclerotic and retina, as far as the ciliary ligament, where it appears on the external surface to terminate, but when a portion of it is raised, its internal surface will be found to extend inwards, in the form of folds or processes, termed ciliary, to be examined presently; the external surface of the choroid is smooth, and loosely connected to the sclerotic by the ciliary vessels and nerves, and by fine cellular tissue; this surface is generally tinged by the pigment which transudes through it; on this layer of the choriod, numerous fine vascular ramifications, running in parallel arches, may be observed; these are connected chiefly with the veins, and are termed the vasa vorticosa; raise a portion of the choroid, by tearing it from the retina with a forceps; its internal surface is covered by a brown pigment, which is thicker before than behind, for a small distance round the optic nerve it is deficient; wash off this pigment, the choroid will be found, if previously injected, to be very vascular and villous; this, the internal layer, which by dissection can be separated from the external, is termed membrana Ruyschiana; the ciliary arteries supply this coat with blood, for the purpose of secreting the pigment, which has the effect of absorbing all rays of light which strike the sides of the retina; the optic nerve passes through a round opening in this membrane, the edges of which are not connected to the nerve; this tunic is more dense anteriorly than posteriorly.

The *Ciliary Ligament* corresponds to the junction of the iris to the choroid, and of the cornea to the sclerotic; it forms a ring of gray color, about two lines broad, of a soft and cellular texture, and has some resemblance to a ganglion.

The *Ciliary Processes* are sixty or seventy small triangular folds of the choroid coat, which are arranged in a radiated manner around the lens on the fore-part of the vitreous humor, each extends inwards and backwards from the ciliary ligament as far as the border of the lens; each of these processes, as well as the interstices between them, are covered by the pigmentum nigrum, the term corona ciliaris is applied to this part; the anterior edge of each process is connected to the ciliary ligament and iris, the posterior to the vitreous humor, and the internal is loose, and forms the circumference of the posterior chamber of the eye.

The *Iris* is a delicate circular membrane, floating in the aqueous humor and suspended vertically behind the cornea, so as to divide the space between this and the lens into two chambers, an anterior and a posterior, the former is the larger of the two; these chambers communicate through the central aperture in the iris, the *Pupil:* this aperture is a little nearer its nasal than its temporal side; the external border of the iris is fixed to the ciliary ligament, its posterior surface is also in part attached to the same and to the ciliary processes; this surface is covered by pigment, and is named uvea; the anterior

surface is covered by the fine membrane of the aqueous humor, and streaked with different colored lines, some of which take a radiated course from the circumference towards the pupil, near which they cross, divide, and unite again, and appear to form or to end in a fasciculus of circular fibres, which bound the pupil, and which are of a darker tint. The iris, when examined with a magnifying glass, has a villous appearance; when the pigment is washed off the posterior surface, the fibrous structure is evident there also, and bristles may even be passed beneath some of the fasciculi; the iris is supplied with numerous arteries and nerves; the former are branches of the long and anterior ciliary, the latter are derived from the lenticular ganglion, and from the nasal nerve; it is not generally agreed on whether the fibrous appearance of the iris depends on the peculiar arrangement of its vessels and nerves, or whether it possesses a true muscular structure; its functions may lead one to incline to the latter opinion, as the pupil has the power of contracting rapidly when a strong light approaches the eye, and of again dilating when the light is weak; the use, therefore, of the iris is to regulate the quantity of light which is to enter the eye. The pupil is closed in the fœtus by a delicate but vascular membrane, the *membrana pupillaris;* this membrane is ruptured either at, or a short time previous to birth.

The *Retina* may be best exposed by gently tearing off the choroid (the eye being held under water), and then placing an inverted glass globe filled with clear diluted spirits over the dissection, the retina will become slightly opaque, and have a magnified appearance. The optic nerve having pierced the choroid coat ends in this thin and delicate membrane, which is transparent in the very recent eye, but soon becomes opaque after death; the retina extends around the sides and fore-part of the vitreous humor without adhering to it, as far forwards as within two lines of the lens; here the nervous matter ends by an abrupt line, along which a small blood vessel runs. The retina is divisible into three layers: first, lamina serosa; second, lamina nervosa; and third, lamina vasculosa. The external or serous layer is extremely delicate, it may be separated by gentle pressure with the handle of the knife, under water. This membrane was discovered by Dr. Jacob. The middle, or the nervous layer, is soft and gray, and continuous with the optic nerve; the internal or vascular layer is very delicate; it lies on the vitreous humor, and is continued on its fore-part to the capsule of the lens, where it becomes adherent to the hyaloid membrane. Dissect off the posterior half of the retina from the vitreous humor, or cut transversely a fresh eye, and allow the humors to fall out, then look on the concave surface of the retina, and we may observe in the centre of the optic nerve a small dark point, the *porus opticus;* this is the central artery of the retina, which then spreads its branches in the internal layer of the retina; about two lines external to this, and in the axis of the eye, is a small yellow or orange spot, the *punctum aureum;* the retina is thrown into folds around this; some describe a perforation and deficiency of the retina at this spot, it rather appears, however, to depend on some peculiar organization. The humors of the eye are the aqueous, crystaline, and vitreous.

The *aqueous humor* is perfectly colorless, about five grains in quantity; it fills the anterior and posterior chambers, the former about two lines, the latter about half a line in depth. This fluid is supposed to be secreted by a fine

membrane, which is continued from the cornea over the iris, and through its pupillary margin to its posterior surface; in the human eye, however, it is impossible to trace any such membrane through this extent. This fluid supports the cornea and the iris, the latter can float and move freely in a fluid of such thin consistence.

The *crystaline humor* is a transparent double convex lens, a little more prominent behind than before, imbedded in the fore-part of the vitreous humor behind the anterior third of the eye, and a little nearer to its nasal than its temporal side. Its axis corresponds to that of the pupil; it is surrounded by a fine capsule, which is thin and soft posteriorly, but anteriorly dense, and peculiarly elastic; a small quantity of fluid (liquor Morgagni) is contained between the lens and its capsule; the lens is retained in its place by the hyaloid membrane, which splits into two laminæ at its border; these laminæ pass, one before, the other behind it, and become connected to the proper capsule; a small triangular canal (canal of Petit) is enclosed between these layers, the base is formed by the circumference of the lens. This canal is intersected by fine septa, it therefore presents a cellular or vesicular appearance when distended by air or injection. Some describe this canal as formed by the division of the lamina vasculosa into two layers. The lens is soft and pulpy externally, more dense towards the centre, or a little internal to that point; maceration or boiling causes it to separate into wedge or triangular shaped pieces, the apices towards the centre: each piece appears composed of successive plates, and each plate has a fibrous structure. In the fœtus the lens is reddish and very soft; in the adult it is transparent, and in the old it has an amber or yellowish cast towards the centre: the capsule of the crystaline lens receives some fine vessels from the central artery of the retina. The lens refracts the rays of light, and causes them to converge to a focus on the retina.

The *vitreous humor* fills the two posterior thirds of the globe of the eye, it is thin and almost watery, but being enclosed in a fine membrane, it has a gelatinous consistence; this membrane is called *hyaloid,* it encloses the fluid, and sends processes into it, so as to divide the whole mass into numerous cells, which communicate so freely that air injected will rapidly distend them; or if one or two openings be made in this capsule, the whole of the fluid will gradually escape; anteriorly the crystaline lens is connected to this humor by the hyaloid membrane separating into two laminæ; external to the lens, the ciliary processes and the intervening pigment mark it in a striated manner, like the disk of a flower; this appearance, therefore, has been called the ciliary disk, or corona ciliaris: the vitreous humor serves to support and expand the retina, and the other tunics of the eye, also, in transmitting the rays of light from the lens, it prevents their too rapid convergence, and thus causes an image of larger size to be painted on the retina.

§ 5.—*Of the Skin.*

The integument of the body is composed of one continued membrane, which is very dense, at the same time very extensible; at the several orifices, it is continuous with the mucous membranes, a vascular line alone marks the distinction between them: by maceration or putrefaction the skin may be

divided into three laminæ, the cuticle, rete mucosum, and cutis vera. The *cuticle* or *epidermis* is the external layer of the skin, it is dry, thin, and transparent, and destitute of nerves and vessels, it is most intimately connected to the cutis by numerous fine hairs which pass through it, also by the several exhalant and absorbent vessels that open on its surface by very minute pores; in some situations it is very dense and opaque, as in the hands and feet; it is continued as a very fine pellicle into the different orifices, and can be traced for a considerable distance on the mucous membranes, thus, from the lips it extends over the pharynx and along the œsophagus as far as the cardiac orifice of the stomach, where it terminates in a fimbriated margin; from the external ear it extends along the meatus externus, and covers the membrana tympani; inferiorly also it is continued along the mucous lining of the urethra, vagina, and rectum; the cuticle serves to defend certain parts of the body from pressure, to protect its surface from contact, and to prevent evaporation. The *rete mucosum* is a thin vascular lamina, adhering to the cutis, connected to it by vessels, it has a villous appearance, and is tinged with a mucous fluid, which presents different shades of color in different situations and in different individuals; the peculiar complexion or color of the body depends upon this secretion: in the negro, it is very thick and black, while the cuticle is transparent and the cutis vascular and red; some anatomists divide the rete mucosum into two, and some even into three or four laminæ. The *cutis vera*, *dermis* or *chorion*, is much more dense than either of the preceding laminæ, it is very tough and strong, in some situations more so than in others; its internal surface is cellular, its external is smooth and very vascular, it is also highly sensible, particularly in some situations, as in the fingers and toes, where numerous nerves are distributed to it in the form of small conical or oval papillæ; these are very distinct at the end of each finger, they are very vascular, and into each a nervous filament can be traced, in these papillæ the sense of touch more particularly resides. The subcutaneous cellular tissue is connected to the deep surface of the cutis, which is itself cellular; the *cellular membrane* is considered by some as a part of the integuments; in some parts of the body, particularly if exposed to pressure, the cells are filled with adeps, in other situations, where the parts are subject to motion, the cells are very loose, and only contain a fine serous exhalation; the former species of cellular membrane has been named *adipose membrane*, the latter *reticular membrane.*

PART III.

ANATOMY OF THE VASCULAR SYSTEM.

UNDER THIS HEAD WE MAY CONSIDER THE ANATOMY OF THE ARTERIES, VEINS, AND LYMPHATICS.

CHAPTER I.

ANATOMY OF THE ARTERIES.

THE principal blood-vessels have been already described in the anatomy of the different regions; in the present section the arteries shall be considered in a systematic manner, commencing with the aorta, and tracing its branches through all parts of the body.

AORTA arises from the upper part of the left ventricle, opposite the 4th or 5th dorsal vertebra, (see page 44,) ascends obliquely forwards and to the right side, then turns backwards and to the left, and then descends along the dorsal vertebræ; it thus forms the *arch* which terminates on the left side of the 4th vertebra: the *thoracic aorta* descends along the left side of the remaining dorsal vertebræ, inclining a little to their fore-part inferiorly, and passes between the crura of the diaphragm: the *abdominal aorta* descends on the lumbar vertebræ, as far as the 4th or 5th, where it divides into the two common iliac arteries. The aorta is at first covered by the pericardium and the pulmonary artery; as it ascends it lies between this vessel and the vena cava; the arch lies on the trachea a little above its division, and on the bodies of the 2d and 3d vertebræ. In the posterior mediastinum the aorta descends on the left of the thoracic duct and vena azygos, and rather behind the œsophagus In the abdomen it lies between the crura of the diaphragm and the psoæ muscles, on the left side of the vena cava and behind the vena porta, the pancreas and the peritonæum. From the arch of the aorta five arteries arise, the right and left coronary, the innominata, the left carotid, and left subclavian.

The right and left coronary arteries arise above two of the sigmoid valves; the *right* proceeds along the base towards the right side of the heart, divides into several long branches, which supply the parietes of the right auricle and ventricle, and communicate with the left coronary: the *left* descends obliquely along the left side of the heart supplying the parietes of the left auricle and ventricle, and communicating with the former around the base and apex of the heart.

The *arteria innominata* arises from the upper part of the arch, ascends obliquely to the right side, in front of the trachea, and behind the sterno thyroid muscle, and the left vena innominata; opposite the sternal end of the clavicle it divides into the right subclavian and right carotid arteries.

The *right and left carotid arteries;* the *right* arises from the arteria innominata, the *left* from the arch of the aorta; these vessels ascend obliquely outwards as high as the os hyoides, opposite which each divides into the internal and external; in this course they are covered inferiorly by the sterno-mastoid, hyoid, and thyroid, and omo-hyoid muscles; and superiorly, only by the skin, platysma, and fascia; the left is also covered inferiorly by the sternum and the vena innominata, and at its origin differs from the right in lying on the trachea, thoracic duct and œsophagus, but after this both ascend in front of the longus colli and rectus capitis muscles, the inferior thyroid artery, and the recurrent and sympathetic nerves, and are enclosed in a sheath of cellular membrane, along with and to the tracheal side of the vagus nerve and the internal jugular vein.

The *external carotid artery* ascends obliquely backwards to the fore-part of the meatus auditorus, covered by the skin, platysma, and fascia, also, by the lingual nerve, digastric and stylo-hyoid muscles, the parotid gland and portio dura nerve; it lies superficial to the internal carotid, stylo-pharyngeus, and stylo-glossus muscles, the glosso-pharyngeal nerve, and part of the parotid gland; it gives off the following arteries, anteriorly, the superior thyroid, lingual, and labial; posteriorly, the muscular, auricular, and occipital; superiorly, the pharyngeal, transverse facial, temporal, and internal maxillary.

The *superior thyroid artery* arises opposite the cornu of the thyroid cartilage, descends obliquely forwards and inwards beneath the sterno-thyroid, and omo-hyoid muscles, and sends off the following branches:—1st, the *superficial,* distributed to the integuments and superficial muscles; 2d, the *laryngeal,* accompanying the superior laryngeal nerve between the os hyoides and thyroid cartilage, and distributed to the muscles and mucous membrane of the larynx; 3d, *hyoidean,* small and irregular, to the lower border of the os hyoides and adjacent muscles; and 4th *superior thyroid,* is distributed to the thyroid gland.

The *lingual artery* arises immediately above the preceding, it ascends tortuously and obliquely forwards and inwards, above the os hyoides to the base of the tongue, between the hyo and the genio-hyo-glossi muscles, and then runs horizontally forwards towards the tip of the tongue; it gives off the following branches, 1st, *hyoidean,* small and irregular; 2d, *dorsalis linguæ,* which ascends to the dorsum of the tongue, and is lost on the mucous membrane, near its base, also on the velum and fauces; 3d, *sublingual,* passes forwards and outwards to the sublingual gland, mylo-hyoid muscle, and mucous membrane of the mouth; and 4th, *ranine,* which continues along the lingualis muscle to the tip of the tongue.

The *labial* or *external maxillary artery* arises opposite the os-hyoides, ascends obliquely forwards behind the digastric and between the submaxillary gland and the base of the jaw, turns round the latter anterior to the masseter muscle, and then ascends obliquely forwards and inwards towards the side of the nose; in the neck it gives off, 1st, *inferior palatine,* which ascends along the side of the pharynx, and supplies the velum and the amygdala; the branch

to the latter often arises distinctly; 2nd, *glandular* to the submaxillary and adjoining lymphatic glands; 3rd, *sub-mental* runs along the mylo-hyoid muscle to the chin, and supplies the surrounding muscles. On the face it gives off, 4th, *inferior labial* to the muscles and integuments between the lip and the chin; 5th, the *inferior and superior coronary*, these run along the border of the lips close to the mucous membrane and directly join those from the opposite side; 6th, *lateralis nasi* to the muscles and skin on the side and dorsum of the nose; and 7th, *angularis*, which communicates with the ophthalmic.

The *muscular artery* descends obliquely backwards, divides into several branches, which are principally distributed to the sterno-mastoid muscle and to the surrounding cellular tissue and glands.

The *occipital artery* arises opposite the labial, ascends obliquely backwards behind the digastric, then curves horizontally backwards between the mastoid process and the atlas, and near the mesial line it ascends on the occiput: it gives off several muscular branches, some to the mastoid and trapezius muscles, several to the deep muscles on the side and back of the neck, and on the occiput it divides into tortuous branches, which ascend in different directions in the scalp, and inosculate with the different arteries in that region.

The *posterior auricular artery* arises above, often in common with the occipital; it ascends behind the parotid and between the meatus auditoris and the mastoid process; it divides into several branches which are lost in the integuments of the ear and in the scalp.

The *inferior* or *ascending pharyngeal artery* arises near the division of the common carotid, ascends vertically to the base of the skull, and sends off several pharyngeal and palatine branches, and ends in a small branch that passes through the foramen lacerum posterius, and supplies the dura mater at the base of the cranium.

The *transverse artery of the face* arises from the carotid in the parotid gland, accompanies the duct of Steno, and is distributed to the muscles and integuments of the face, and joins the branches of the facial artery.

The *temporal artery* ascends through the parotid gland between the meatus auditorius and the articulation of the maxilla, behind the zygoma, and divides on the temporal fascia into an anterior and posterior branch; it gives off, 1st, *branches to the gland;* 2nd, *anterior auricular;* 3rd, the *middle temporal;* this pierces the fascia and is distributed to the temporal muscle; 4th, the *anterior* or *frontal* supplies the skin and muscles of the forehead, and joins the ascending branches of the ophthalmic artery; 5th, *posterior temporal* bends backwards and upwards in the scalp and inosculates with the occipital and auricular arteries.

The *internal maxillary artery* ascends obliquely forwards behind the neck of the maxilla, between the pterygoid muscles, then between the external pterygoid and the temporal muscle; it then bends down into the pterygo-maxillary fossa; it gives off the following branches, 1st, while internal to the neck of the maxilla, the *middle artery of the dura mater;* this ascends to the base of the cranium, passes through the spinous hole of the sphenoid bone, then runs outwards and forwards, and again ascends along the great wing of the sphenoid bone to the inferior angle of the parietal, which bone it grooves very deeply; it then ascends between this bone and the dura mater, divides

into several branches, which ascend obliquely backwards, and are lost in the bone and the dura mater; 2d, the *inferior dental* arises opposite the last, descends obliquely forwards between the bone and the internal lateral ligament, enters the dental foramen, and proceeds beneath the teeth, to the roots of which it sends very small arteries, and through the mental hole it sends a small branch to the muscles and mucous membrane, and to inosculate with branches of the labial artery; between the pterygoid muscles it sends off, 3rd the *deep temporal* branches, one posterior, the other anterior; these supply the muscle and ascend close to the bone; 4th, *masseteric;* 5th, *pterygoid;* 6th, *buccal,* to the buccinator muscle, the fat and integuments of the cheek; 7th, *superior dental,* which winds round the maxillary tuberosity and sends branches into the alveoli and to the gums; in the spheno-maxillary fossa it gives off, 8th, *infra-orbital,* which passes along the canal of that name, is distributed to the muscles of the face, and communicates with the arteries of that region; 9th, *nasal* passes inwards through the spheno-palatine hole, and is distributed to the mucous membrane on the spongy bones and on the septum; 10th, the *superior palatine* descends along the posterior palatine canal, and is distributed to the muscles and to the mucous membrane of the palate, principally to the hard palate; 11th the *vidian;* this is a small branch which passes backwards and takes the course of the first part of the vidian nerve; these terminating branches of the internal maxillary artery are entangled with the divisions of the superior maxillary nerve.

The *internal carotid artery* ascends along the vertebral column and the side of the pharynx from the common carotid, posterior and external to the external carotid, behind the digastric and styloid muscles, internal to the jugular vein and anterior to the vagus and sympathetic nerves, to the foramen caroticum in the petrous bone; it then bends tortuously forwards, upwards, and inwards, through the carotid canal, accompanied by the superior branches of the sympathetic, enters the cavernous sinus, through which it makes two remarkable turns internal to the sixth pair of nerves, and arriving at the anterior clinoid process, it bends upwards and backwards, and a little outwards, and opposite the internal extremity of the fissure of Sylvius it divides into its three terminating branches, it first gives off the ophthalmic artery; in the neck, and in the carotid canal, it sends small and unimportant branches to the surrounding parts.

The *ophthalmic artery* arises close to the anterior clinoid process, passes forwards through the optic foramen, below the optic nerve and external to it; in the orbit it rises above this nerve and twines round it to the inner side of this cavity, along which it passes to the inner canthus, where it terminates; while on the outer side of the optic nerve it sends off, 1st, *centralis retinæ,* very small, pierces the sheath of the optic nerve, passes along the centre of the latter, into the eye, where it divides into delicate ramifications; these spread along the internal layer of the retina, and one or two pierce the vitreous humour, and extend to the capsule of the lens; 2nd, the *lachrymal* passes along the external rectus muscle, and supplies the lachrymal gland, and the external part of the palpebræ: while above the optic nerve it gives off: 3rd the *supra-orbital,* which passes forwards along the levator palpebræ, and though the superciliary notch, supplies the muscles and integuments of the eye-brow, and ascending on the forehead, divides into several branches, which are distributed

to the scalp, and communicate with the temporal and occipital arteries; 4th, *the posterior ciliary*, ten or twelve in number, very small surround the optic nerve, and pierce the back part of the sclerotic; pass between it and the choroid, and are distributed to the latter; some of their branches continue as far as the ciliary processes and the iris; 5th, *long ciliary* one on each side; they pass horizontally forwards, between the sclerotic and choroid membranes, as far as the ciliary circle; here they divide, and form a circular inosculation round the circumference of the iris, from this several branches radiate inwards, and again unite in a circle near the pupil; 6th, *muscular arteries,* to the different muscles in the orbit; 7th, *ethmoidal,* passes through the posterior orbital foramen to the mucous membrane in the ethmoid cells; 8th, *superior and inferior palpebral,* to the palpebræ, caruncula, conjunctiva, and lachrymal sac; 9th, *nasal,* passes beneath the trochlea, along the side of the nose, and inosculates with the labial artery; 10th, *frontal,* ascends to the eye-brow and forehead.

The *posterior communicating artery* arises from the carotid, opposite the ophthalmic; passes backwards and inwards external to the corpora mamillaria, and joins the posterior cerebral artery; this artery forms the lateral part of the circle of Willis; it sends several branches to the surrounding pia mater.

The *anterior cerebral artery,* or *arteria callosa,* passes forwards and inwards above the optic nerve; anastomoses with the opposite, by a short transverse branch, (the anterior communicating artery,) it then bends upwards and backwards round the corpus callosum, on which it terminates by dividing into branches for the corresponding hemisphere of the cerebrum.

The *middle cerebral artery,* very large, passes outwards in the fissure of Sylvius, and divides into two tortuous branches, which supply the anterior and middle lobes of the cerebrum. (See page 180.)

The *subclavian arteries;* the *right* arises from the arterial innominata, and proceeds nearly transversely outwards, between the scaleni muscles, then obliquely downwards and outwards behind the clavicle; it is covered at first by the sterno-mastoid, hyoid, and thyroid muscles; by the internal jugular vein, the vagus, and branches of the sympathetic nerve; next, by the phrenic nerve and anterior scalenus muscle, and externally only by the skin, platysma, and fascia; it first passes over the recurrent nerve, the longus colli muscle, and sympathetic nerve; next, the pleura and middle scalenus muscle, and lastly, the first rib. The *left subclavian* arises from the posterior part of the arch of the aorta, ascends nearly vertically out of the chest; then turns outwards and downwards between the scaleni muscles, and over the first rib; in the chest this artery lies very deep, and is covered by the pleura and the lung, also by the vena innominata, the vagus, the sternum, and the muscles attached to it; it lies near the vertebræ, along the side of the œsophagus and thoracic duct; in the rest of its course, its relations are similar to those of the right; each sends off the following branches, vertebral, thyroid axis, internal mammary, superior intercostal and deep cervical.

The *vertebral artery,* arises from the upper and back part of the subclavian; ascends behind the inferior thyroid artery, enters the foramen in the transverse process of the 5th or 6th cervical vertebra, and ascends through the several foramina in the superior vertebræ as high as the second; it then bends

backwards and outwards; passes through the foramen in the transverse process of the atlas: it then turns backwards and inwards, round the articulation of this vertebra with the condyle, and pierces the dura mater; it then ascends obliquely inwards and forwards between the olivary and pyramidal bodies, and at the lower edge of the pons it unites with the opposite, to form the basilar artery; in this course it gives small branches to the spinal nerves and to the inter-vertebral muscles: at the foramen magnum it gives off, 1st and second, the *posterior and anterior spinal arteries*, which descend all along the spinal cord; 3d, the *inferior cerebellar artery* often arises from the basilar; it runs tortuously around the medulla oblongata, below the vagus, and sends its numerous branches to the inferior surface of the cerebellum.

The *basilar artery*, is formed by the confluence of the two vertebral; it ascends into the median groove on the pons varolii, sends small branches to the surrounding membrane, and at the upper edge of that body it divides into four branches, two for each side, 1st the *superior cerebellar artery*, passes outwards and backwards, to the upper surface of each hemisphere of the cerebellum on which it spreads its branches, 2d, the *posterior cerebral artery*, this receives the posterior branch of the internal carotid, bends backwards and outwards, and spreads its ramifications on the posterior lobe of the cerebral hemisphere. (See page 221.)

The *thyroid axis*, arises from the upper part of the subclavian close to the scalenus and phrenic nerve, it immediately divides into the four following branches:—1st, the *inferior thyroid*, ascends tortuously behind the common carotid, then bends downwards and inwards, sends branches to the trachea, œsophagus, &c. and is distributed to the thyroid gland, in which it inosculates with the superior thyroid, and with the arteries of the opposite side; 2d, the *ascending cervical* ascends along and is distributed to the anterior scalenus, longus colli, and rectus capitis anticus major muscles; 3d, *supra-scapular* runs obliquely outwards and downwards beneath the clavicle, passes above the notch in the superior costa of the scapula, supplies the supra-spinatus muscle descends beneath the acromion process to the infra-spinatus and teres minor muscles: 4th, *transversalis colli* ascends obliquely outwards round the scaleni muscles, and beneath the trapezius, it divides into two branches, one, the *cervicalis superficialis*, supplies the superficial muscles on the side and back part of the neck; the other, the *posterior scapular artery*, descends beneath the levator anguli scapulæ, and the rhomboid muscles along the base of the scapula as far as the inferior angle, where it inosculates with the subscapular artery; the posterior artery of the scapula, as also the supra-capsular in many subjects, arise distinctly from the subclavian artery.

The *internal mammary artery* arises opposite the thyroid axis, it descends obliquely forwards and inwards, between the cartilages of the ribs and the pleura, as far as the ensiform cartilage, it gives branches to the pleura, pericardium, and mediastinum, a long branch to the diaphragm, which accompanies the phrenic nerve, also intercostals; it terminates by sending branches to the diaphragm, and to the abdominal muscles, the latter inosculate with the epigastric artery.

The *superior intercostal artery* arises between the scaleni, descends behind the pleura, in front of the neck of the 1st and 2d ribs, and supplies the two first pair of intercostal muscles.

The *cervicalis profunda* arises opposite the last, ascends obliquely backwards and outwards, between the transverse processes of the 6th and 7th cervical vertebræ, and ascending on the back of the neck, supplies the complexus and the other deep muscles in that region, and inosculates with the descending branches of the occipital artery.

The *axillary artery* descends from the lower edge of the first rib, obliquely outwards to the tendon of the latissimus dorsi muscle, it is covered by the integuments, and at first by the external border of the great pectoral muscle, lower down by the great and lesser pectoral, and still lower down by the tendon of the great pectoral only; it passes over the first intercostal, and serratus magnus muscles, the brachial plexus, the sub-scapular and the tendons of the latissimus dorsi and teres major muscles; the axillary vein descends along its inner and anterior part, and the brachial plexus lies posterior and external to it, it sends off the following arteries, the thoracica acromialis, the superior and long thoracic, the sub-scapular, the posterior, and anterior circumflex.

The *acromoial thoracic artery* arises from the front of the axillary below the subclavian muscle, above the lesser pectoral, and opposite the fissure between the great pectoral and deltoid muscles; it divides into several branches, which pass some to the pectoral muscles, others to the acromion process, deltoid muscle, and integuments of the shoulder and arm, one long branch accompanies the cephalic vein.

The *superior thoracic artery* arises a little below the preceding, sometimes in common with it, it passes forwards and inwards, and divides into branches which supply the cellular membrane and glands in the axilla, the pectoral muscles, the breast, and the integuments.

The *long thoracic artery* arises below the lesser pectoral, descends obliquely forwards along the side of the chest, parallel to the lower edge of the great pectoral, to which it sends some branches, it terminates in the intercostal muscles and integuments, and inosculates with the internal mammary and the intercostal arteries.

The *sub-scapular artery* arises opposite to and descends along the lower edge of the sub-scapular muscle, and soon divides into an anterior and posterior branch; the former continues to descend along the back part of the axilla, and supplies the sub-scapular, serratus magnus, and latissimus dorsi muscles; the latter passes backwards round the inferior costa of the scapula, behind the long tendon of the triceps; and above the latissimus and teres major muscles, it is distributed on the dorsum of the scapula to the infra-spinatus and teres minor muscles, and inosculates with the supra-scapular artery.

The *posterior circumflex artery* arises below the last, sometimes in common with it, it passes out of the axilla between the long tendon of the triceps and the humerus, turns round this bone between it and the deltoid muscle, to which last it sends numerous branches.

The *anterior circumflex artery* is smaller than the preceding, and arises either from it or from the axillary; it passes outwards round the anterior part of the humerus, beneath the deltoid, coraco-brachialis, and biceps; to these muscles it sends its branches; it also sends one long branch along the bicipital groove to the synovial membrane of the shoulder joint.

The *brachial artery* descends obliquely outwards to the bend of the elbow, where it divides into the radial and ulnar arteries; it is covered by

the skin and brachial aponeurosis, and inferiorly by the fascia of the biceps, and the median basilic vein; it lies on the inner side of the coraco-brachialis and biceps, and passes over the upper part of the triceps, the coraco-brachialis, and the brachiæus anticus; it is accompanied by a vein on either side, also, by the median nerve, which above lies to its outer, and below to its inner side, it passes superficial to the artery about the middle of the arm; in addition to several muscular branches it sends off the superior and inferior profunda, and the anastomotica.

The *superior profunda* arises below the teres major, accompanies the musculo-spiral nerve obliquely downwards and outwards, between the three heads of the triceps, and in the musculo-spiral groove of the humerus; it divides into two large branches, one descends in the triceps to the olecranon, the other accompanies the radial nerve to the outer condyle, and communicates with the radial recurrent artery.

The *inferior profunda* arises opposite the tendon of the coraco-brachialis, descends on the surface of the triceps, along with the ulnar nerve, to the inner condyle, and communicates with the ulnar recurrent.

The *anastomotica* arises about two inches above the joint, passes inwards, supplying the adjacent muscles, and inosculating with the preceding and with the ulnar recurrent arteries.

In the triangular hollow at the bend of the elbow, the brachial artery divides into the radial and ulnar.

The *ulnar artery* is the larger of the two, it descends along the ulnar side of the fore-arm to the palm of the hand, covered superiorly by the superficial flexors and pronators, and by the median nerve; inferiorly by the skin and fascia, overlapped, however, by the tendons of the flexor digitorum sublimis and flexor carpi ulnaris, between which it descends to the wrist; it passes over the brachiæus anticus, flexor profundus, pronator quadratus, the annular ligament of the carpus and the flexor tendons in the palm of the hand; it is accompanied by two veins, and by the ulnar nerve, the latter descends along its ulnar side; it gives off, 1st, the *anterior ulnar recurrent* which ascends in front of the inner condyle, on the brachiæus anticus, and inosculates with the anastomotica; 2d, the *posterior ulnar recurrent* large and tortuous, ascends behind the inner condyle, along the ulnar nerve, and anastomoses with the anastomotica and inferior profunda arteries; 3d, *inter-osseal artery*, passes backwards and divides into an anterior and posterior branch; the *anterior inter-osseal artery* descends along the fore-part of the inter-osseal membrane, beneath the deep flexors, pierces that membrane near the pronator quadratus, and descends on the back part of the carpus, and is distributed to the carpal bones, and to the sheaths of the extensor tendons; the *posterior inter-osseal artery* passes backwards beneath the anconæus, and descends along the back of the fore-arm, sending its branches to the extensor muscles; this artery superiorly sends a very large recurrent branch in the anconæus muscle to the olecranon, to communicate with the superior profunda; 4th, *muscular branches* to the two layers of flexor muscles, and to the skin; 5th, *dorsalis carpi ulnaris* turns round the lower end of the ulna, and spreads its branches on the back part of the wrist and hand; 6th, *superficial palmar*, forms the palmar arch, bends obliquely across the palm of the hand towards the thumb, and inosculates with branches of the radial artery;

7th, *ramus profundus*, passes beneath the flexor tendons, crosses the 5th and 6th metacarpal bones, and joins the deep palmar branch of the radial artery, and thus completes the deep palmar arch; from the superficial arch long digital branches pass, these divide and supply the opposite sides of all the fingers, except the radial side of the index finger and the thumb.

The *radial artery* continues in the direction of the brachial artery; it passes along the radial side of the fore-arm to the wrist, turns round the external lateral ligament of this joint, then passes forwards between the heads of the two first metacarpal bones into the palm of the hand, and terminates in three branches; in the fore-arm it is covered by the skin and fascia only, lies between the supinator longus externally, and the pronator teres, and flexor carpi radialis internally; it passes over the biceps, supinator brevis, pronator teres, flexor digitorum sublimis, flexor pollicis, and pronator quadratus; it is accompanied by two veins, and the radial nerve is to its external side in the middle of the fore-arm; on the outer side of the wrist it is covered by the extensor tendons of the thumb, and on the back of the hand by the skin and fascia, it gives off, 1st, *radial recurrent*, large and tortuous, bends outwards and upwards along the supinators and extensors, to which it sends several branches, and inosculates with the superior profunda; 2d, *muscular branches* to the flexors and supinators; 3d, *superficialis volæ* passes over the annular ligament of the carpus, supplies the small muscles of the thumb, and inosculates with the ulnar artery; 4th, *dorsalis carpi radialis*; 5th, *dorsales pollicis*, these branches are distributed as their names imply; 6th, *radialis indicis*, runs along the radial side of the fore-finger; 7th, *magna pollicis* runs along the first metacarpal bone, and divides into two branches, which pass along the opposite sides of the thumb to its last phalanx; 8th, *palmaris profunda* passes across the metacarpal bones, joins the deep branch of the ulnar, and thus forms the deep palmar arch, from which several branches proceed to the inter-osseal muscles, and to the bones and ligaments of the metacarpus.

The Thoracic Aorta gives off the bronchial, œsophageal, and intercostal arteries.

The *bronchial arteries* are two or three in number, they arise from the fore-part of the aorta, below the arch; they pass to either side, enter the back part of the root of each lung, and are lost in the cellular tissue of these organs; these arteries sometimes arise from the intercostal, they are very irregular in number and size.

The *œsophageal arteries* are also irregular, generally three or four in number; they arise from different parts of the aorta, send branches to the mediastinum and œsophagus; on the latter some ascend, others descend; the former inosculate with the cervical arteries, the latter with the abdominal.

The *intercostal arteries*, in general ten on the left, nine on the right side, the superior intercostal on the right side being larger than that on the left; they arise from the back part of the aorta, pass obliquely outwards behind the pleura, and enter the intercostal spaces, run along the lower edge of each rib between the layers of muscles, and about the middle of the chest divide into an inferior and superior branch; the former, smaller, runs along the superior border of the lower rib: the latter continues in the groove in the upper; they both supply the intercostal muscles and send branches through these to the

pleura and to the superficial muscles of the chest; they inosculate with the internal mammary and with the thoracic arteries. Each intercostal artery, before it enters the intercostal space, sends a large branch backwards between the transverse process of the vertebræ to the muscles on the posterior part of the trunk, these *dorsal branches* of the intercostal arteries also send small branches through the inter-vertebral holes along the spinal nerves to the medulla spinalis.

The Abdominal Aorta sends off the following branches: the phrenic, cœliac axis, superior mesenteric, inferior mesenteric, renal, supra-renal, spermatic, lumbar, and middle sacral.

The *phrenic arteries* arise in common, or near each other, from the fore-part of the aorta; they both send branches to the supra-renal capsules and to the crura of the diaphragm; the *right* ascends behind the vena cava; the *left* behind the œsophagus; on the diaphragm each divides into an external and internal branch; the former passes towards the circumference of the muscle, and inosculates with the internal mammary and the inferior intercostals; the latter encircles the central tendon, communicates with its fellow and with the phrenic branches of the mammary.

The *cœliac axis* arises from the fore-part of the aorta opposite the last dorsal vertebra; it soon divides into three branches, 1st, the *gastric artery* ascends obliquely to the left side, to the cardiac orifice, to which and to the œsophagus it sends several branches; it then bends along the lesser curvature towards the right side between the laminæ of the lesser omentum, and inosculates with the superior pyloric artery; it sends its branches to the anterior and posterior surfaces of the stomach; 2d, *hepatic artery* ascends obliquely towards the right side, in front and to the left side of the vena porta and ductus choledochus, and in the transverse fissure of the liver, divides into right and left hepatic arteries; in this course it gives off the *superior pyloric*, which passes along the upper surface of the pylorus and joins the gastric artery; and the *gastro-duodenalis* which descends between the pylorus and the duodenum; this gives off *inferior pyloric* branches, and divides into the *pancreatico-duodenalis* and *gastro-epiploica dextra:* the former takes a curved course between the duodenum and the pancreas, sending branches to each, and inosculates with the superior mesenteric artery; the latter turns forwards, and to the left side along the great curvature of the stomach, between it and the laminæ of the great omentum, to which, as well as the stomach, it sends numerous branches, and inosculates with the gastro-epiploica sinistra, a branch of the splenic artery; the right and left hepatic arteries then separate and plunge into the substance of the liver, accompanying the branches of the vena porta: the right hepatic is the larger, and before it enters the gland it gives off the *cystic artery* which supplies the parietes of the gall-bladder; 3d, the *splenic artery* is the longest branch of the cœliac axis; it passes backwards and to the left side along the upper edge of the pancreas, to which it sends several branches; near the spleen it gives off the *gastro-epiploica sinistra;* this bends forwards, and to the right side along the great curvature of the stomach, and between the laminæ of the great omentum, it inosculates with the corresponding branch from the hepatic artery; the splenic next sends off the *vasa brevia,* five or six small branches which pass to the great end of the

stomach, and inosculate with the proper gastric arteries; the splenic artery then divides into several branches, which enter the foramina on the concave surface of the spleen, and ramify through its spongy substance.

The *superior mesenteric artery* arises a little below the cœliac, descends obliquely forwards and to the left behind the pancreas, and over the duodenum; it then passes between the layers of the mesentery and takes an arched course towards the right iliac fossa: from its concave side arise three branches, the *ilio-colic, right colic,* and *middle colic;* these three branches proceed between the lamina of the meso-colon to the large intestine, each divides into two branches, which unite with those on either side, and form arches, from the convexities of which branches arise, some of which subdivide and unite again in the same manner as the first branches; near the intestine straight branches proceed on the anterior and posterior surface, and supply the muscular and mucous coats; from the convex side of the mesenteric artery eighteen or twenty branches arise, these proceed between the laminæ of the mesentery, divide, and form arches, from which new branches arise, these again divide, and again unite in an arched manner; these divisions and subsequent inosculations occur three or four times before the arteries arrive at the intestine; near the latter each branch divides into two, which proceed in a direct course, one on the anterior, the other on the posterior surface of the intestine, and are distributed principally to the mucous membrane.

The *inferior mesenteric artery* arises about two inches below the preceding; it descends towards the left iliac fossa and divides into three branches, left colic, sigmoid, and superior hæmorrhoidal; the *left colic* ascends in the left meso-colon, anastomoses with the middle colic branch of the superior mesenteric, and supplies the left part of the colon; the *sigmoid artery* is distributed to the sigmoid flexure of the colon; the *superior hæmorrhoidal* descends along the back part of the rectum, supplies the coats of this intestine, and inosculates with the middle and inferior hæmorrhoidal arteries.

The *renal arteries* arise from the sides of the aorta, between the superior and inferior mesenteric arteries; the right is longer than the left; it passes across the spine behind the vena cava; both pass behind their corresponding vein and divide near the kidney into five or six branches, which ramify through the substance of this gland.

The *capsular arteries* are two or three in number; they arise either from the renal arteries or from the aorta; they supply the renal capsules.

The *spermatic arteries* arise from the fore-part of the aorta; the left frequently arises from the renal artery; they are long and tortuous, descend obliquely outwards, crossing in front of the psoas muscle and the ureter; in the male they accompany the vas deferens through the inguinal canal, and supply the testicle and epididymis; in the female they pass to the ovarium, and also send branches to the Fallopian tubes, and to the sides of the uterus.

The *lumbar arteries* are four or five pair; they arise from the back part of the aorta, pass obliquely outwards through the psoas, send branches between the transverse processes of the lumbar vertebræ, to the muscles of the back and loins, and terminate in the abdominal muscles.

The *middle sacral artery* arises from the back part of the aorta a little above the bifurcation; it descends nearly in the median line close to the sacrum,

sends its branches to this bone, and communicates with the lateral sacral arteries.

The *common iliac arteries* descend obliquely outwards as far as the ilio-sacral articulations, opposite which each divides into the internal and external iliac; the right iliac is longer than the left, and passes over the commencement of the vena cava.

The *internal iliac* or *hypogastric artery* passes downwards and forwards into the pelvis to the side and back part of the bladder, where it ends in a ligamentous substance, which ascends first along the side of the bladder, and then behind the recti muscles as far as the umbilicus; the internal iliac artery gives off the following branches, ilio-lumbar, lateral sacral, hæmorrhoidal, vesical, uterine and vaginal, the glutæl, sciatic, obturator, and pudic. 1st, The *ilio-lumbar* arises from the back part of the internal iliac, passes outwards behind the external iliac vessels and the psoas muscle, into the substance of the iliacus internus, in which it divides into ascending and descending branches. 2nd, The *lateral sacral* descends obliquely inwards in front of the sacral holes, through which it sends branches to the spinal nerves, also to the pyriform muscle, and to communicate with the middle sacral. 3rd, The *hæmorrhoidal* are two or three branches of uncertain origin, they pass to the sides of the rectum and communicate with the superior and inferior hæmorrhoidal arteries. 4th, The *vesical arteries* arise from the iliac, or from some of its branches; they ramify on the coats of the bladder; the inferior also supply the parts about the neck of this organ. 5th, The *uterine* and *vaginal arteries* either arise from the internal iliac or from some of its branches, and are distributed as their names imply. 6th, The *glutæal artery* passes backwards and outwards from the pelvis by the upper part of the sciatic notch, above the pyriform muscle, and divides into several branches, some of which supply the glutæus maximus, others pass forwards in a semicircular course towards the spine of the ilium, and supply the glutæus medius and minimus muscles. 7th, The *obturator artery* passes out of the pelvis by the superior part of the thyroid hole into the upper part of the thigh beneath the pectinæus, and divides into several branches to supply the obturator and adductor muscles. 8th, The *sciatic artery* passes over the pyriform muscle and escapes from the pelvis by the lower part of the sciatic notch, along with the sciatic nerve; it sends several branches to the glutæus maximus, the hamstrings, and adductor magnus; also to the small capsular muscles and to the sciatic nerve; these communicate with the circumflex and perforating arteries. 9th, The *internal pudic artery* smaller than the preceding, leaves the pelvis along with it below the pyriform muscle, re-enters the cavity between the sciatic ligaments, and then ascends obliquely inwards and forwards along the tuber and ramus of the ischium and ramus of the pubis, and a little below the symphysis pubis divides into two branches. In the pelvis the pudic at first gives small branches to the adjoining viscera; as it is passing round the spine of the ischium, and between the sciatic ligaments, it gives small branches to the surrounding ligaments and muscles; when it has re-entered the pelvis it gives off, 1st, *external hæmorrhoidal arteries*, two or three, they pass transversely to the side of the rectum and anus, and supply the integuments and muscles in that region; 2nd, the *perinæal artery* first descends, then turns forwards and upwards

round the transversus perinæi, proceeds along the perinæum, and is distributed to the muscles and integuments in this situation, and to the scrotum; 3rd, *transversalis perinæi,* a small branch arising near to and often from the preceding; it takes the course of the muscle of that name, and is lost in the muscles and integuments; 4th, *artery of the bulb,* passes transversely between the layers of the triangular ligament, enters the spongy substance of the bulb, and spreads its branches through the corpus spongiosum urethræ; 5th and 6th *artery of the corpus cavernosum* and *dorsalis penis;* the former enters and extends along the corpus cavernosum, the latter along the dorsum of the penis as far as the glans. In the female the pudic artery gives off branches to the perinæum and labia, and to the corpus cavernosum and dorsum of the clitoris, analogous to, but smaller than those in the male.

The *external iliac artery* proceeds from the common iliac downwards and outwards to Poupart's ligament, beneath which it passes and receives the name of femoral; it lies along the inner side of the psoas, the vein is internal and posterior to it, it gives off near the groin two branches; 1st, *circumflexa ilii* arises from its outer side, ascends obliquely outwards as far as the crest of the ilium where it divides into several branches, some pass to the abdominal muscles, others to the iliacus internus and quadratus lumborum, and communicate with the ilio-lumbar artery; 2nd, the *epigastric artery* arises from its fore-part, a little above Poupart's ligament, it at first descends, then turns forwards and ascends between the abdominal muscles and the peritonæum, crosses behind the spermatic cord, a little internal to the internal inguinal ring; about three or four inches above the pubis it enters the sheath of the rectus, divides into branches which ascend in this muscle to the umbilicus, and inosculate with the mammary artery.

The *femoral artery,* or the continuation of the external iliac, descends obliquely inwards from the middle of the crural arch, along the anterior and internal part of the thigh, covered superiorly by the skin, superficial fascia, inguinal glands and fascia lata: in the middle of the thigh it is also covered by the sartorius, and beneath this by a strong aponeurosis connecting the vastus internus to the tendons of the adductor longus and magnus, at the inferior part of the middle third of the thigh, it passes obliquely backwards through a tendinous opening, bounded externally by the vastus internus, internally by the adductor magnus, superiorly by the adductors magnus and longus, and inferiorly by the adductor magnus and vastus internus; the femoral artery first passes over the psoas and iliacus, next over the pectinæus and short adductor, from which it is separated by a quantity of cellular membrane and by small vessels, it next passes over the tendon of the adductor longus; the femoral vein descends along with it, at first internal, afterwards posterior to it; the anterior crural nerve is external to it, two or three of its branches are very near it, above the middle of the thigh, one small nerve crosses the artery, and the saphenus nerve descends in its sheath along the fore-part of the vessel; it sends off, 1st, three or four superficial branches, viz.: *inguinal branches* to the inguinal glands, &c.; the *superficial pudic,* one or two in number, which pass towards the pubis and are lost in the integuments; the *superficial epigastric* the longest and largest of these branches, ascends obliquely inwards towards the umbilicus, parallel to the internal epigastric, and is lost in the integuments; the *external circumflex ilii* extends along

Poupart's ligament to the crest of the ilium, where it terminates in the skin; 2nd, the *profunda* is the largest branch of the femoral, it arises about two inches below the crural arch, from the outer and back part of the femoral artery, bends a little outwards at first, then descends obliquely inwards and backwards behind the femoral artery, and the tendon of the adductor longus, passing over the psoas, cruræus, and adductor brevis, at the back part of the thigh it terminates in two branches for the hamstring muscles; in this course it gives off the two circumflex, and the three perforating branches; the *external circumflex artery*, arises from the outer part of the profunda, passes transversely beneath the sartorius and rectus muscles, and divides into three fasciculi of branches, superior, middle, and inferior, the first ascend along the tensor vaginæ and glutæus medius muscles, and inosculate with the glutæal artery, the second pass round the bone to its back part, and inosculate with the glutæal, sciatic, and internal circumflex arteries; the third are the longest and largest branches, they descend towards the knee and supply the extensor muscles. The *internal circumflex artery* arises sometimes below, sometimes above the preceding, it often proceeds from the femoral itself, it passes backwards between the psoas and pectinæus, along the obturator externus tendon, to the back part of the thigh, first sending off several branches to the surrounding muscles, and to the hip joint, also some to inosculate with the obturator artery; at the back of the thigh it gives several branches to the gemelli, quadratus, glutæus maximus, and the hamstrings, and inosculates with the external circumflex and sciatic arteries; the *first* or *superior perforating artery* passes backwards beneath the lesser trochanter, between the pectinæus and adductor brevis, and through the adductor magnus, its branches are distributed to the latter and to the hamstrings; the *second* or *middle perforating artery* larger than the first, passes through the adductor brevis and magnus, and spreads its branches among the muscles on the back of the thigh; the *third* or *inferior perforating artery* descends behind the adductor longus, and through the magnus to the hamstrings; on the back part of the thigh the profunda ends in two branches, one passes to the biceps, the other to the semi-membranosus.

After the origin of the profunda, the femoral gives off several small muscular and cutaneous twigs, and near the opening in the triceps, though which it passes, it gives off, 3rd, the *anastomotica magna*; this descends in front of the adductor tendon to the knee, sends several branches, to the integuments, vastus internus, and to the patella; these inosculate with the long branches of the external circumflex artery above, and with the articular arteries below.

The *popliteal artery* descends from the inner side of the femur, obliquely outwards to the inferior and central part of the popliteal space; it is covered by the skin and fascia, and overlapped superiorly by the semi-membranosus, and inferiorly by the gastrocnemius and plantaris muscles; the popliteal vein lies superficial and external to it; the sciatic nerve is still more superficial and external; its branches are, 1st, several muscular branches to the hamstrings and to the gastrocnemius; 2nd, *superior articular* encircle the lower extremity of the femur, turn round the sides, to the fore-part of the joint, and communicate with the anastomotica and with the branches of the external circumflex; 3rd, *azygos-articular* passes forwards through the posterior ligament

of the joint, and supplies the synovial membrane and the adipose substance in its cavity; 4th, *inferior articular arteries*, encircle the lower part of the joint; the internal passes round the head of the tibia, the external is beneath the external lateral ligament; these arteries pass round the joint to its fore-part, inosculate with the preceding and with the anterior tibial recurrent; at the lower part of the ham the popliteal divides into the anterior and posterior tibial arteries.

The *anterior* perforates the inter-osseous space close to the head of the fibula, descends obliquely forwards along the inter-osseous membrane and over the lower part of the tibia, the synovial membrane of the ankle and the superior and internal part of the tarsus to the first inter-osseal space; in the leg it is overlapped by the tibialis anticus internally, by the extensor communis and extensor pollicis externally, it passes beneath the annular ligament of the ankle; on the tarsus it is covered by the skin and by the internal tendon of the extensor brevis; it is accompanied by two veins; the anterior tibial nerve descends superficial and external to it; it gives off, 1st, the *recurrent* which passes upwards and inwards, and is lost around the articulation of the knee; 2nd, *muscular* branches, very numerous to the muscles on the outer and anterior part of the leg; 3rd, *malleolar branches*, which ramify on the external and internal malleoli; on the former they inosculate with the anterior peronæal; 4th and 5th, *tarsal* and *metatarsal* are distributed to the bones and ligaments of the tarsus and metatarsus; between the two first metatarsal bones it divides into, 6th and 7th, the *arteria pollicis* and the *communicans*; the former supplies the integuments of the great toe; the latter the first inter-osseal muscle, and inosculates with the plantar arteries.

The *posterior tibial artery* descends obliquely inwards between the superficial and deep layer of muscles on the back of the leg, to the space between the heel and inner ankle, where it divides into the internal and external plantar arteries; it is covered by the gastrocnemius and solæus, and lies on the tibialis posticus, flexor communis, and inferiorly on the tibia; it is accompanied by two veins, and by the posterior tibial nerve, which lies to its external side; it gives off, 1st, several muscular branches to the deep and superficial muscles; 2d, the *peronæal artery* arises about an inch below the popliteal, descends obliquely outwards towards the external ankle; between the fibula and flexor pollicis; sends numerous branches to the muscles of the leg, and about two inches above the ankle divides into the *anterior* and *posterior peronæal* branches; the former pierces the inter-osseous ligament, and inosculates with the external malleolar; the latter spreads its branches on the outer side of the heel and of the foot; between the heel and inner ankle the posterior tibial divides into the internal and external plantar; the *internal plantar* proceeds along the internal side of the sole of the foot, supplying the muscles and integuments of the great toe, and inosculating with the adjacent vessels both on the dorsum and in the sole of the foot; the *external plantar* much larger than the preceding, passes forwards and outwards above the flexor digitorum brevis, as far as the 5th metatarsal bone; it then bends across the metatarsus, along the transversalis pedis, as far as the 1st metatarsal bone where it joins the anterior tibial, and thus forms the plantar arch, from which proceed numerous muscular branches, and the digital arteries; these last arise from the anterior or convex edge of the arch pass forwards, supplying the lumbricales and interossei muscles, and divide each into two branches to supply the opposite sides of the toes.

§ 2.—*Anatomy of the Veins.*

In addition to the veins which accompany the arteries, the relative situation of which has been already considered, there are also several veins which run independent of these, and take a superficial or subcutaneous course. It is impossible to fix the exact point at which a vein commences; it is generally considered that the arteries having terminated in minute ramifications or capillaries, the veins commence from these, so that in reality each vein is a returning artery only altered in structure; some veins are said to commence from cells, as in the spleen and corpora cavernosa penis; we shall describe the veins then as proceeding from the extreme parts of the body towards the centre or towards the heart; and 1st,

The *veins* of the *head* and *neck;* the small arteries which ramify on the side and fore-part of the scalp are accompanied each by two veins, these all terminate in the *temporal veins* which sink into the parotid gland and there join the *internal maxillary* vein, which is formed by the confluence of the several small veins which accompany the branches of the internal maxillary artery; the union of these two veins is the commencement of the *external jugular vein* which descends a little backwards nearly parallel to the fibres of the platysma, across the sterno-mastoid muscle, and at a little distance above the clavicle enters the subclavian vein, or some of its branches; near the angle of the jaw this vein receives a branch from the facial vein, and in its course down the neck it is joined by several cutaneous branches; it also not unfrequently communicates with the internal jugular vein by one or two small branches near the os hyoides.

The *internal jugular vein* commences in the foramen lacerum posterius basis cranii, from the termination of the lateral sinus, it descends along the outer side of the carotid artery, receives the facial, laryngeal, and several muscular veins, and opposite the sternal end of the clavicle joins the subclavian vein.

The *veins of the upper extremity* are superficial and deep, the *superficial* are the cephalic, basilic, and median.

The *cephalic vein* commences on the outer and back part of the carpus from the junction of the several dorsal veins of the hand, it ascends along the radial side of the fore-arm to the bend of the elbow, is there joined by the median cephalic, it then continues to ascend along the outer side of the biceps; near the shoulder it turns forwards and passes towards the clavicle between the pectoral and deltoid muscles, and then sinks deep to join the axillary vein.

The *basilic vein* commences near the lower end of the ulna, one branch from the little finger is named the *vena salvatella,* the others are irregular in number and size, it ascends along the ulnar side of the fore-arm, before the internal condyle, where it is joined by the median basilic vein, it then continues to ascend along the inner side of the arm, accompanying the brachial vessels, and near the axilla it joins one of the venæ comites or the axillary vein itself.

The *median vein* arises a little above the wrist, ascends along the middle of the fore-arm to the bend of the elbow, it here divides into two branches,

one (median basilic) joins the basilic vein, the other (median cephalic) joins the cephalic vein, sometimes a third branch joins one of the deep veins. The *deep* veins accompany the brachial artery and its branches in the arm and fore-arm, two with each; these end in the *axillary vein*, which ascends in front of the artery, receives the thoracic veins, passes beneath the clavicle, and is then named *subclavian vein;* this passes inwards, over the anterior scalenus, receives several veins from the shoulder and side of the neck, also the external jugular and vertebral veins, and opposite the sterno-clavicular articulation unites with the internal jugular vein to form the *vena innominata,* which on the right side is a short trunk that descends into the thorax behind the sterno-thyroid muscle, and opposite the cartilage of the first rib joins that from the left side, which is longer, and takes a more transverse course as it enters the chest, in front of the trachea, and of the arteria innominata; this vein receives several branches from the thyroid gland and from the anterior mediastinum. The *vena cava superior* or *descendens* commences opposite the first costal cartilage on the right side, descends obliquely inwards in front of the right pulmonary vessels, enters the pericardium, and opposite the third or fourth cartilage it opens into the right auricle; as it enters the pericardium it is joined by the *vena azygos* which commences by a small branch on the first lumbar vertebra, which often communicates with the inferior vena cava; this vein then ascends through the aortic opening of the diaphragm into the posterior mediastinum along the right side of the dorsal vertebræ and of the aorta, receiving the intercostal veins from each side, also the œsophageal and bronchial; at the 4th vertebra it curves forwards round the root of the right lung, and opens into the back part of the vena cava.

The veins of the lower extremity are superficial and deep; the *former,* the internal and external saphena; the *external* passes from the dorsum of the foot behind the external malleolus, ascends along the back of the leg to the ham, and joins the popliteal vein; the *internal saphena* commences on the upper and inner part of the foot, ascends in front of the inner ankle along the inner side of the leg, and behind the internal condyle of the knee; it then inclines to the internal and anterior part of the thigh, and ascends to within about two inches of Poupart's ligament, it then passes through the saphenic opening in the fascia lata and joins the femoral vein; the *deep veins* of the leg accompany the arteries, two with each, they terminate in the popliteal vein, which ascends superficial and external to the artery; this vein then receives the name of *femoral,* and is closely connected to the artery, lying posterior to it below, and on its inner side above; this then passes behind the crural arch and becomes the *external iliac,* which lies internal and rather posterior to the accompanying artery; opposite the ilio-sacral symphysis this is joined by the *internal iliac vein,* which arises from the union of the several veins that accompany the branches of the internal iliac artery; the union of the external and internal iliac veins constitute the *common iliac* which ascends on each side towards the right side of the 4th lumbar vertebra, and unite to form the inferior vena cava; the left common iliac vein is longer than the right, and runs obliquely across the spine; both are posterior to the corresponding arteries. The *inferior vena cava* ascends along the right side of the lumbar vertebræ, on the psoas and left crus of the diaphragm, to the liver, passes through a groove in this organ between the right and middle lobes, and then through the large quadrangular opening in the tendon of the diaphragm perforates the pericardium,

and opens into the lower and back part of the right auricle; it receives the middle sacral, the spermatic, the renal, and capsular, and lastly the hepatic and the phrenic veins. The *vena portæ* receives the blood from all the abdominal viscera except the kidneys, bladder and uterus; a large vein commences on the back of the rectum (*hemorrhoidal*) ascends towards the mesocolon and becomes the *inferior mesentric* vein which accompanies the artery of the same name; about the 2d lumbar vertebra this unites with the *superior mesentric* vein, which accompanies the artery of that name also; behind the pancreas this trunk is joined by a very large vein, *the splenic,* which returns the blood from the spleen, and also receives the veins from the great and lesser curvatures of the stomach, from the duodenum and pancreas; this large vein passes transversely behind the pancreas and below the splenic artery; the vena portæ is formed by the union of the splenic and mesenteric veins, in front of the aorta, and behind the pancreas; it then ascends to the right side, enclosed in the lesser omentum and behind the hepatic artery and ductus choledochus; in this course it receives small veins from the omentum, pancreas, and gall-bladder; at the transverse fissure it divides at right angles into a right and left branch, which pass horizontally for a short distance, and form what is termed the *sinus of the porta;* this rests on the lobulus caudatus; these branches then enter the liver, and ramify through its substance along with the branches of the hepatic artery and duct, and surrounded by the capsule of Glisson.

The vena portæ has no valves, whereas all the veins of the extremities are furnished with these, also the superficial veins of the neck; the deep veins of the neck, the vena azygos, and the pelvic veins, are deprived of valves; the coats of the vena portæ are more dense and fibrous than those of most other veins; the femoral vein also possesses such a very dense structure, that when divided it will often remain open like an artery.

§ 3.—*Anatomy of the Lymphatic System.*

The lymphatic vessels have a great resemblance to veins, they are furnished with numerous valves, and are arranged in two sets, a superficial and deep; both of these accompany the veins, that is, proceed from the extreme parts towards the centre, the greater number terminate in the thoracic duct, some however end in the veins on the right side, and recent observations seem to prove, that in different situations the lymphatic and venous system are more closely allied than was formerly believed; the lymphatics are extremely minute, in some situations they cannot be demonstrated, as in the brain, in such probably the veins perform the additional office of absorption; it is uncertain in what manner these vessels commence, whether by open mouths in the different structures, or whether they are fine returning arteries taking the same course as the veins, and only differing from the latter in their delicacy of size, in having more numerous valves, in not transmitting the colored particles of blood, and in being connected with the lymphatic or conglobate glands.

The lymphatics of the lower extremities are *superficial* and *deep,* the first accompany the external and internal saphena veins; those which take the course of the external saphena, end in the popliteal glands, where they unite with the deep lymphatic vessels which take the course of the tibial and fibular

veins and arteries; the lymphatics which accompany the internal saphena vein ascend to the groin, pass through the inguinal glands, and communicate not only with all the deep lymphatics of the limb, but also with the superficial vessels from the abdomen, perinæum, and genital organs; the deep-seated lymphatics about the hip and the perinæum accompany the branches of the internal iliac artery and vein into the pelvis, where they pass through the pelvic lymphatic glands; the lymphatics from the inferior extremities and from the pelvis ascend towards the spine, form a plexus round the iliac arteries, and pass behind the aorta close to the vertebræ, and terminate in the receptaculum chyli, or the commencement of the thoracic duct, into which numerous lymphatic or lacteal vessels open from the intestinal canal. The lacteal or chyliferous vessels commence from open mouths on the surface of the intestine, and thence pass through the mesenteric glands, increasing in size and diminishing in number, towards the spine. The lymphatics of the stomach take the course of the arteries of that viscus, also towards the spine, and join the thoracic duct. The lymphatics of the liver are superficial and deep, the former are very distinct, some pass back towards the spine, others ascend along the falciform ligament, enter the thorax, and proceed through the anterior mediastinum to the thoracic duct near its termination; the deep lymphatics pass, some out of the transverse fissure, others from the posterior edge of the liver on the diaphragm, all then pass back towards the spine.

The *thoracic canal* commences on the body of the 2d or 3d lumbar vertebra by a large dilatation, named the *receptaculum chyli*; it then ascends between the crura of the diaphragm into the posterior mediastinum, and is situated on the right of the aorta, on the left of the vena azygos, and behind the œsophagus; with these relations, it rises to about the 5th dorsal vertebra, and then crosses the spine obliquely to the left side, passing behind the œsophagus and the arch of the aorta; it then again ascends, and is placed beneath the left pleura, between the left carotid and subclavian arteries, and along the left side of the œsophagus, it rises into the neck, as high as the 6th vertebra, behind the carotid and thyroid arteries, and jugular vein; it then curves outwards and downwards, and opens into the left subclavian vein, close to the jugular. Two valves internally protect this opening, these are situated one at either side. The thoracic duct receives in its course along the thorax several branches from the lungs, the heart, and the parietes of the chest; in the neck, the lymphatics from the left arm and left side of the head, face, and neck, open into it. The lymphatics of the upper extremities are superficial and deep, the former accompany the sub-cutaneous veins to the elbow, and a little above the bend of the joint they pass inwards through a small gland that is situated above the inner condyle; they then join the deep lymphatics, and ascend along the inner side of the arm to the axilla, pass through the axillary conglobate glands, surround the axillary artery, and pass with it beneath the clavicle into the neck, where they are joined by the lymphatics from the neck and shoulder. On the left side these branches end in the thoracic duct; on the right side they form a short canal (called the right or lesser thoracic duct) which opens into the right or left vena innominata, at the upper part of the anterior mediastinum.

ANATOMY OF THE FŒTAL CIRCULATION.

The *umbilical vein* which arises by numerous branches from the placenta, and extends along the umbilical cord, twisted round the umbilical arteries,

enters the umbilicus of the fœtus, ascends obliquely backwards, enclosed in the duplicature of the falciform ligament, behind the linea alba, and the right rectus muscle; it arrives at the notch in the anterior edge of the liver, proceeds backwards along the horizontal fissure, sending branches to either side, particularly to the left lobe, which at this period of life is of considerable size. When the umbilical vein arrives near the transverse fissure, it divides into two branches; the right or communicating, the left or the ductus venosus, the *right* is the larger, it passes transversely for about an inch and joins the trunk of the vena portæ; the *left*, or the *ductus venosus*, ascends between the left and spigelian lobes towards the diaphragm, and joins the middle hepatic veins just as these are about to join the vena cava. The right auricle distended with blood from the superior and inferior vena cava, then contracts and propels its contents partly into the right ventricle, but principally through the foramen ovale into the left auricle. From the right ventricle the blood is propelled into the pulmonary artery; this vessel in the fœtus divides into three branches, one for either lung small, and one in the centre very large, the *ductus arteriosus*, this is about half an inch in length, passes backwards and downwards, and joins the aorta a little below its arch; but little blood passes through the lateral branches, the principal portion passing thrugh the ductus arteriosus into the aorta. That portion of blood which was transmitted directly from the right auricle, through the foramen ovale into the left auricle, descends into the left ventricle, from which it is also propelled into the aorta, the superior branches of which circulate the blood through the upper parts of the body, whence it is returned to the heart by the veins that form the superior vena cava. The descending aorta conveys the blood to the abdominal viscera, and at the fourth lumbar vertebra this vessel divides into the external and internal iliac arteries, the former is small in the child, the latter is very large, and is named the umbilical or hypogastric artery, this passes forwards and upwards along the side of the bladder, approaches its fellow, and ascends to the umbilicus; these arteries then twine around the umbilical vein in the cord, and arriving at the placenta divide into numerous branches, which ramify through this organ; these two arteries thus serve the office of veins. The external iliac arteries descend as in the adult, and the blood which they circulate is returned by the corresponding veins. The iliac veins unite at the fourth lumbar vertebra, and commence the inferior vena cava, which ascends, and as in the adult, passes through the liver, is joined by the hepatic veins, and then terminates in the right auricle of the heart.

In connection with the fœtal heart, the student may remark the *thymus gland* this body fills the upper part of the anterior mediastinum, ascending as high as the thyroid gland, and descending in front of the pericardium, and the great vessels, nearly as low as the diaphragm; it consists of two lobes of an oval figure, close in the centre, but separated at either end. It lies on the trachea, the left vena innominata, the arch of the aorta, and the pericardium, is covered by the sternum and steno-thyroid muscles, and is surrounded by a loose capsule of cellular membrane. It consists of several small lobules which are filled with a whitish fluid. Several of the organs of the body presents peculiarities in the fœtus, these have been already noticed in the description given of each in the adult state.

PART IV.

DISSECTION OF THE JOINTS.

When all the muscles, vessels, nerves, &c. have been dissected, the student may examine the anatomy of the joints: in almost every articulation we find a smooth and delicate membrane extended over the articulating surface of each bone; this is termed a synovial membrane, it forms a shut sac like a serous membrane, and constantly contains a small quantity of glairy fluid termed synovia; this membrane is generally protected externally by ligaments, which also serve to connect the bones together; these ligaments are termed *capsular* when they surround the joint, as in the shoulder and hip; when they are confined to a particular part they are termed *accessory* ligaments, or *lateral*, *anterior*, *posterior*, &c. &c.

TEMPORO-MAXILLARY ARTICULATIONS.

Each condyle of the inferior maxilla is received into that portion of the glenoid cavity of the temporal bone, which is anterior to the fissure, it also moves on the transverse root of the zygoma; this joint is strengthened by the external and internal lateral and the stylo-maxillary ligaments, an inter-articular cartilage, two synovial membranes, and an imperfect capsular ligament.

The *external lateral ligament arises* broad from the zygomatic process of the temporal bone, descends obliquely back, and is *inserted* narrow into the outer side of the neck of the condyle of the lower jaw.

The *internal lateral ligament* is thinner and longer than the external, it *arises* narrow from the spinous process of the sphenoid bone, descends obliquely forwards and is *inserted* broad into the orifice of the inferior dental canal.

The *stylo-maxillary ligament* is a thin aponeurosis, *arises* from the styloid process of the temporal bone, passes forwards and outwards; is connected to the cervical fascia, and to the stylo-glossus muscle, and is *inserted* into the angle of the lower maxilla, between the masseter and internal pterygoid muscles, and the parotid and sub-maxillary glands.

The *synovial membranes*, one covers the cartilaginous surface of the zygomatic eminence and the glenoid cavity, and is reflected over the upper surface of the inter-articular cartilage: the other, which is smaller, covers the under surface of the inter-articular cartilage, and is reflected over the condyle; these sacs have no communication with each other.

The *inter-articular fibro-cartilage* is of an oval figure, thick in its circumference, thin in the centre. Its upper surface is adapted to the articular

eminence and glenoid cavity, and its lower surface to the condyle. Some fibres of the external pterygoid are attached to its forepart, the external lateral ligament also adheres to it: sometimes there is a hole in the centre of it.

The *capsular ligament* consists of dense fibres which *arise* from the zygomatic eminence and from the glenoid fissure, as they descend they adhere to the inter-articular cartilage, and are *inserted* into the neck of the lower jaw; this ligament is deficient anteriorly, at the insertion of the external pterygoid muscle.

ARTICULATION OF THE OCCIPUT WITH THE ATLAS AND AXIS.

The condyles of the occipital bone are received into the superior oblique processes of the atlas, and are attached by imperfect *capsular ligaments*, by *synovial membranes* which cover the opposed cartilaginous surfaces, and by an *anterior and posterior ligament* which are attached superiorly to the anterior and posterior edges of the foramen magnum, and inferiorly to the upper edge of the atlas, before and behind its oblique processes.

The occipital bone, though not in contact with, is yet connected to the axis by the two lateral or moderator ligaments, and by the apparatus ligamentosus colli.

The *lateral ligaments arise* from each side of the odontoid process, ascend obliquely outwards, and are *inserted* into the inner side of each condyle.

The *apparatus ligamentosus* (or the perpendicular ligament of some anatomists) is a flat fasciculus of fibres, which descend from the lower part of the cuneiform process, behind the odontoid process, and is *inserted* into the superior part of the transverse ligament of the atlas in the middle, and into the bodies of the second and third vertebræ on either side, on these it becomes continuous with the posterior common vertebral ligament.

ARTICULATION BETWEEN THE ATLAS AND AXIS.

These two vertebræ are not only connected by synovial membranes and fibrous bands around these, and by a ligament anteriorly and posteriorly as in all the other vertebræ, but the odontoid process is also secured in the atlas by a transverse ligament and synovial membranes.

The *transverse ligament* describes the fourth of a circle, it is thick and fibro-cartilaginous in the centre, is attached on each side to the inner edge of each oblique process of the atlas, and is connected in the centre by some of the fibres of the apparatus ligamentosus, to the cuneiform process superiorly, and to the body of the axis inferiorly; there is also a *synovial sac* connected to the posterior surface of the odontoid process, and to the anterior surface of this ligament; *another synovial membrane* covers the opposed cartilaginous surfaces of the atlas and the processus dentatus: by means of these several ligaments all rotatory motion between the occiput and the first vertebra is prohibited, whereas between the atlas and the axis it can occur freely.

THE COMMON ARTICULATIONS OF THE VERTEBRÆ.

The bodies of the vertebræ are united by an anterior, a posterior, and inter-vertebral ligaments.

The *Anterior Vertebral Ligament* is a strong band of fibres extending from the axis to the sacrum, and adhering to the bones and inter-vertebral substances: beneath this band other fibres are seen crossing obliquely between the bodies of the vertebræ. This ligament is narrow in the cervical and lumbar regions, broader and more distinct in the dorsal; it consists of three planes of fibres, viz. the superficial extend over four or five vertebræ; the middle over two or three, and the third only cover a single vertebra.

The *Posterior Vetebral Ligament* extends down the back part of the bodies of the vertebræ, along the front of the spinal canal; it consists of smooth glistening fibres; it is narrow in the dorsal, and broad in the lumbar and cervical regions.

The *Inter-vertebral Ligaments or Fibro-cartilages* are placed between the bodies of all the vertebræ, except between the atlas and dentata. They are united very firmly above and below to the flat surfaces of the vertebræ. In the neck and loins they are thicker in front than behind, the contrary in the back; they are formed of concentric layers of fibrous matter decussating each other, and having intervals between them, which are more considerable towards the centre. These intervals are filled by a soft elastic pulpy tissue, which is gradually increased in quantity towards the centre.

The articulating processes of the vertebræ are connected by synovial membranes, and by ligamentous fibres extended irregularly between them.

Between the back part of the plates of the vertebræ are the *ligamenta sub-flava.* These ligaments close the intervals between the vertebræ, and thus complete the back part of the spinal canal. They exist between all the vertebræ, from the second to the sacrum; they are composed of dense, yellow, elastic fibres, united angularly to each other towards the base of each spinous process.

The spinous processes of the vertebræ are also connected to each other by ligamentous bands, termed *supra-spinous,* and *inter-spinous* (the ligamenta sub-flava might be called infra-spinous). Between the transverse processes also ligamentous fibres exist which are named *inter-transverse* ligaments.

ARTICULATIONS OF THE RIBS.

The head of each rib is joined to the spine by an anterior and an inter-articular ligament, and by synovial membrane; the *anterior ligament, arises* from the front of the head of the rib, and thence extends over the articulation in a radiated manner, and is *inserted* into the side of the vertebra above and below, and into the inter-vertebral substance. The *inter-articular ligament, arises* from the projecting ridge in the articular surface of the rib, and is *inserted* into the cavity in the inter-vertebral substance in which the head is received. The upper and lower divisions of this joint are lined by distinct synovial membranes.

The tubercle of each rib is united to the transverse process of the inferior

of the two vertebræ, to the bodies of which the head is attached by three ligaments and a synovial membrane. First, the *inferior costo-transverse* ascends from the neck of each rib obliquely outwards to the transverse process above; second and third, the *posterior* and *external costo-transverse* connect the tubercle of each rib to the corresponding transverse process. The synovial membranes covering the cartilaginous surfaces of the transverse processes and tubercles of the ribs, are more loose than those belonging to the heads of the ribs.

The cartilages of the ribs at their costal ends are convex, and are very closely united to the concave surfaces in the extremities of the bones. The sternal ends of the cartilages of the seven true ribs are convex, adapted to the hollows in the edge of the sternum; these hollows are covered by cartilage and by synovial membranes; each joint is strengthened by ligamentous bands, which proceed from the cartilage before and behind the articulation, and are expanded upon the sternum. There is no distinct joint between the first rib and the sternum, the cartilage and bone appear to be continuous.

ARTICULATIONS OF THE PELVIS.

THE last lumbar vertebra is joined to the sacrum in the same manner as the other vertebræ are to each other. The last lumbar vertebra is connected to the ilium by the *ilio-lumbar ligament;* this is sometimes divided into two, it *arises* from the transverse processes of the fifth and fourth lumbar vertebræ, and from the back part of the sacrum, proceeds horizontally outwards, and is *inserted* into the posterior superior spinous process and crest of the ilium. The ilium and sacrum are firmly united by a cartilage which consists of two layers, one adhering to each bone; behind this they are connected by short ligamentous fibres, also by the sacro-sciatic ligaments, which are two in number on each side, 1st, the *posterior* or *great sacro-sciatic ligament*, *arises* from the lower and back part of the posterior inferior spine of the ilium, and from the back part of the sacrum and coccyx; descends obliquely outwards, becomes narrow and thick, and is *inserted* into the lower edge of the tuber ischii; 2d, the *anterior* or *lesser sacro-sciatic ligament*, triangular, *arises* from the side of the sacrum and coccyx, passes outwards, and is *inserted* into the spine of the ischium. The coccyx is united to the sacrum by a substance resembling the inter-vertebral, also by ligamentous bands before and behind. The ossa pubis are closely attached by several laminæ of fibro-cartilage; posteriorly a little fluid separates these bones which are each covered by cartilage; this connection is strengthened inferiorly by the *pubic ligament*, which is very dense, and passes from the ramus of one bone to the opposite. *The obturator ligament* is a thin fascia adhering to the margin of the obturator hole, except superiorly, where the thyroid nerve and vessels pass through.

STERNO-CLAVICULAR ARTICULATION.

THE clavicle is connected to the sternum by an anterior, posterior, inferior, and inter-clavicular ligament, also by an inter-articular cartilage and two synovial membranes; the *anterior ligament arises* from the end of the clavicle, descends inwards, and is *inserted* into the fore-part of the sternum;

the *posterior ligaments* takes a course parallel to the preceding, behind the joint; the *inferior* or the *costo-clavicular* or *rhomboid ligaments*, passes from the lower surface of the sternal end of the clavicle, and is *inserted* into the cartilage of the first rib; the *inter-clavicular* extends from the posterior surface of one clavicle to the other, the cervical fascia is attached to the upper edge of this ligament; the *inter-articular cartilage* is thin below, and attached to the sternum, thick above and attached to the clavicle; a synovial membrane is connected to each surface of this cartilage.

SCAPULO-CLAVICULAR ARTICULATION.

The oval end of the clavicle is connected to the end of the acromion process by a *superior* and *inferior ligament*, which are attached to the surfaces of each bone, there is also a synovial membrane between both; sometimes there is an inter-articular cartilage in this articulation; about an inch internal to this joint the clavicle is connected to the coracoid process by two fasciculi of ligamentous fibres, which do not properly belong to this articulation, they are the conoid and trapezoid ligaments.

The *conoid* is the smaller of the two, its base is attached to a tubercle on the lower surface of the clavicle, its apex to the broad part of the coracoid process. The *trapezoid* is more anterior and external, it is also broader and stronger than the conoid, it is about an inch distant from the articulation, it is attached above to an oblique line on the clavicle, and below to the upper part of the coracoid process; these ligaments are united posteriorly and externally, anteriorly they are distinct.

LIGAMENTS OF THE SCAPULA.

These are two in number, an anterior and posterior.

The *anterior*, or the *deltoid* or *coraco-acromial*, *arises* broad from the carocoid process, passes upwards and outwards, and is *inserted* narrow into the point of the acromion process. The *posterior* or *coracoid* ligament *arises* from the costa of the scapula behind the notch, passes forwards, and is *inserted* into the base of the coracoid process; it converts the notch into a foramen: this ligament is sometimes wanting, then the notch is completed into a hole by bone: the supra-scapular nerve usually passes below this ligament, while the vessels of this name run above it.

HUMERO-SCAPULAR ARTICULATION.

The head of the humerus is retained in the glenoid cavity by the capsular and coraco-humeral ligaments, and by a synovial membrane; the glenoid cavity is deepened by a fibrous border, which is partly derived from the tendon of the biceps.

The *capsular* ligament *arises* around the neck of the scapula, increases in size, encircles the head of the humerus, and is *inserted* into its neck; it is dense above and below, thin internally and externally; this capsule is very loose and long, the tendons of the capsular muscles are identified with it.

The *coraco-humeral ligament* extends from the coracoid process to the

anterior part of the great tuberosity, where it becomes confounded with the capsule and with the tendon of the supra-spinatus. The synovial membrane is reflected over the glenoid surface around the glenoid ligament, lines the capsule, and covers the head of the humerus, and also lines the bicipital groove.

HUMERO-CUBITAL ARTICULATION, OR THE ELBOW-JOINT.

THE opposed extremities of the humerus, ulna, and radius, mutually receive each other, and are attached together by an external and internal lateral, and by an anterior and posterior ligament.

The *external* lateral ligament *arises* from the external condyle, and is *inserted* into the annular ligament of the radius; this ligament is confounded with the tendons of the supinator and extensor muscles.

The *internal* lateral *arises* from the inner condyle, and is *inserted* in a radiated manner into the inner edge of the coronoid and olecranon processes, it is longer and broader than the external, is somewhat triangular, and divides inferiorly into two fasciculi, the anterior of which extends to the coronoid process, and is confounded with the common tendinous origin of the muscles of the fore-arm; the posterior is inserted into the olecranon process, is covered by the ulnar nerve and connected to the adjacent muscles; both portions adhere to the synovial membrane.

The *anterior ligament* consists of thin fibres which take an irregular direction over the fore-part of the joint; they arise chiefly from above the internal condyle, and the depression on the fore-part of the humerus; they thence spread over the synovial membrane, behind the brachiæus anticus; some are inserted into the annular ligament of the radius, and the remainder are gradually lost on the synovial membrane.

The *posterior ligament* is not so distinct as the anterior, unless the fore-arm be flexed; the fibres chiefly extend in a transverse direction from one condyle to the other, they are attached to the synovial membrane, and covered by the triceps and anconæus.

The *synovial membrane* is common to the humero-cubital as well as to the cubito-radial articulation; this membrane descends behind the anterior ligament, and a quantity of reddish fatty matter which intervenes, to the neck of the radius and annular ligament; round which it forms a cul de sac, is prolonged into the sigmoid cavities of the ulna, and thence is reflected to the lateral ligaments and to the triceps tendon, which leads it to the posterior depression on the humerus, it is thence expanded over the articular eminences at the lower end of this bone.

RADIO-ULNAR ARTICULATIONS.

THESE are two, a superior and an inferior; in the *superior* the head of the radius is received into the lesser sigmoid cavity of the ulna, and is retained in it by the following ligament. The *annular ligament* forms about three-fourths of a circle; it *arises* from the anterior, and is *inserted* into the posterior border of the lesser sigmoid cavity of the ulna; this ligament is lined by the synovial membrane of the joint, it encircles the head and neck of the radius; it often presents a cartilaginous structure.

The *oblique ligament* is a small round fibrous cord, it *arises* from the coronoid process of the ulna, descends obliquely outwards, and is *inserted* into the radius below its tubercle; it is on a plane anterior to the inter-osseous ligament, and it separates the flexor digitorum sublimis from the supinator radii brevis muscle.

The opposed edges of the radius and ulna are connected by a thin aponeurosis the *inter-osseal membrane* or *ligament;* it is composed of long fibres which descend obliquely inwards from the radius to the ulna; this ligament is deficient above and below, and in many places is perforated by vessels.

In the *inferior radio-ulnar articulation*, the round head of the ulna is received into the sigmoid cavity of the radius, and retained in it by a loose synovial membrane or the sacciform ligament, which is covered before and behind by some ligamentous fibres; it passes from the radius to the ulna, and forms a very loose sac above the following ligament or cartilage; it always contains a quantity of synovia.

The *fibro cartilage* is triangular, it *arises* narrow from the styloid process of the ulna, and is *inserted* broad into the inner edge of the radius below the ulna, which bone it separates from the wrist joint, or from the cuneiform bone, its anterior and posterior edges are connected to the ligamentous fibres that pass from the ulna to the radius.

RADIO-CARPAL ARTICULATION, OR THE WRIST JOINT.

In this joint the lower end of the radius and the inter-articular cartilage form a socket for the scaphoid, lunar, and cuneiform bones; this joint is secured by an external and internal lateral, and by a posterior and anterior ligament.

The *external lateral* extends from the styloid process of the radius and is *inserted* into the scaphoid bone; some fibres extend to the annular ligament and to the os trapezium.

The *internal lateral* extends obliquely downwards and forwards, from the styloid process of the ulna to the cuneiform bone.

The *anterior* and *posterior ligaments* descend from the radius and inter-articular cartilage anteriorly and posteriorly, and are *inserted* into the superior row of the carpus. A synovial membrane covers the superior row of the carpal bones, is thence reflected to line the ligaments, and is continued over the articular surface of the radius, and of the inter-articular cartilage.

The three first bones of the carpus are connected to each other by ligamentous bands, both on the dorsal and palmar aspects, passing in different directions from one bone to another; the pisiform is articulated distinctly to the cuneiform bone: the bones of the second row are connected to each other in the same manner as those of the first, and the two rows are attached by two lateral ligaments and by dorsal and palmar bands, also by the head of the os magnum being received into the cavity formed by the lunar and scaphoid bones; one synovial membrane extends between these two rows, and sends processes between the individual bones, the bones of the carpus are also firmly connected to each other by the *annular ligament*, which is *inserted* externally into the trapezium and scaphoid, internally into the cuneiform and unciform bones.

The articulations between the carpus and metacarpus are secured by transverse and oblique fibrous bands, which cover the synovial membranes, and pass in different directions; the articulations between the heads of the metacarpal bones and the first phalanges are furnished with very loose synovial membranes and lateral ligaments; the phalanges of the fingers are articulated to each other by synovial membranes and lateral ligaments.

ILIO-FEMORAL ARTICULATION, OR HIP JOINT.

The head of the femur is received into the acetabulum, which cavity is deepened by the *cotyloid ligament*, which is a circular fibrous band adhering to the edge of the bony cup, and lined by synovial membrane: the notch at the inner part of the cavity is partly closed by the *transverse ligament*, which is attached to the opposite points of the pubis and ischium.

The *capsule* of this joint is the strongest in the body. It consists, like the capsule of the shoulder joint, of a fibrous and a synovial membrane. The fibrous membrane is attached above to the circumference of the acetabulum; and below to the root of the trochanter major, and to the two oblique intertrochanteric lines; it is very strong externally and anteriorly, thin internally. The synovial membrane is reflected from the inside of the fibrous membrane upon the periosteum of the neck, and upon the cartiliginous surface of the head of the femur; from the latter it is reflected around the inter-articular ligament, and is then continued to the cartilaginous surface of the acetabulum. The attachment of the fibrous layer extends upon the femur, a little way beyond the synovial membrane, especially at the outer and posterior part of the joint.

The *accessory* or *ilio femoral ligament* extends from the inferior spinous process of the ilium obliquely downwards and inwards, adhering to the forepart of the capsule, and is *inserted* into the fore-part of the lesser trochanter.

The *inter-articular ligament*, or *ligamentum teres*, *arises* narrow from the depression on the head of the femur, passes downwards and inwards, and becoming broad, is *inserted* by two fibrous bands into the extremities of the notch in the edge of the acetabulum, and by the synovial membrane to the fatty substance that covers the rough surface at the bottom of the cavity.

FEMORO-TIBIAL ARTICULATION, OR THE KNEE JOINT.

The condyles of the femur, the head of the tibia, and the patella, enter into this articulation; the ligaments which secure it may be classed into those external and those internal to the synovial membrane, although strictly they are all external to it; the external ligaments are, the ligamentum patellæ, ligamentum posticum, and the internal and external lateral ligaments.

The *ligamentum patellæ* consists of strong parallel tendinous fibres which descend from the inferior angle of the patella, and are *inserted* into the tubercle of the tibia, a little below a small bursa which lies behind this ligament; it is partly a continuation of the extensor tendon.

The *posterior ligament* has been noticed in the dissection of the semi-

membranosus muscle, from the tendon of which this ligament *arises*; it then ascends obliquely from behind the inner condyle of the tibia to the external condyle of the femur.

The *internal lateral ligament* is broad and flat, *arises* from the internal condyle of the femur, descends obliquely forwards, and is *inserted* into the internal condyle of the tibia, and into the semilunar cartilage.

The *external lateral ligament* or *ligaments arise* from the external condyle, are thick and round, descend backwards, and are *inserted* into the head of the fibula: a portion of the biceps tendon sometimes separates these ligaments; in many cases they form but a single cord.

The *synovial membrane* of the knee is the largest in the body; it ascends between two and three inches on the fore-part of the femur, is thence reflected to the patella, and to the adjoining muscles or tendons and is continued down to the head of the tibia; it is thence reflected round the inter-articular cartilages, and along the crucial ligaments to the femur.

The internal ligaments in this joint are, the alar, mucous, transverse, crucial, and the semilunar cartilages.

The *alar ligaments* are folds of the synovial membrane, one on either side of the patella and united below that bone.

The *ligamentum mucosum* is a small fold of the same membrane, passing from the fatty substance behind the ligamentum patellæ, backwards and upwards to the hollow between the condyles.

The *transverse ligament* extends between the anterior convex portions of the two semilunar cartilages, and above the fatty substance before alluded to.

The *anterior crucial ligament arises* from the inner side of the external condyle, descends obliquely forwards, and is *inserted* near the fore-part of the head of the tibia.

The *posterior crucial ligament arises* from the outer side of the internal condyle, descends nearly vertical, and is *inserted* partly into the external semilunar cartilage, and partly into the depression on the back of the tibia.

The *semilunar cartilages* are placed upon the articular surfaces of the tibia; the convex margin of each is thick; the internal concave margin has a sharp edge; each cartilage presents above an excavated surface, adapted to the condyles, and below, a flat surface, adapted to the head of the tibia; externally they are connected with the lateral ligaments, while their internal edges are loose in the cavity of the joint. The anterior and posterior extremities of each are fixed to the head of the tibia, before and behind its middle protuberance.

The two cartilages are united in front by the transverse ligament; the external cartilage is circular and more movable than the internal, which is of an oval figure.

The *head of the fibula* is connected to the small smooth surface on the outer side of the head of the tibia, by a synovial membrane, and by an anterior and postertor fasciculus of ligamentous fibres.

The bodies of these two bones are connected by the inter-osseous membrane, which consists of aponeurotic fibres extending obliquely from one bone to the other; they are deficient above and below. The *inferior extremity of the fibula* is received into a depression in the tibia, and connected to it by a strong anterior and posterior ligament, which are, each, of a triangular form, the base

below; also by a synovial membrane, and an intervening dense, fibrous substance: some fibres of the posterior ligament extend from one malleolus to the other and strengthen the ankle joint.

ARTICULATION OF THE ANKLE.

The astragalus is received into a cavity formed in the tibia and fibula, and secured in it by very strong lateral ligaments, and also by a synovial membrane and an anterior ligament.

The *internal lateral* or *deltoid ligament* is very dense it *arises* from the internal malleolus, decends in a radiated manner, and is *inserted* into the astragalus, os naviculare and calcis.

The *external lateral ligaments* are three, a posterior, middle, and anterior; they all *arise* from the external malleolus; the posterior passes obliquely inwards to the ridge on the back of the astragalus between the ankle and the articulation of the astragalus to the os calcis; the middle descends vertically and is *inserted* into the os calcis the anterior is *inserted* into upper and outer part of the astragalus. The *anterior ligament* of the ankle is often indistinct; it *arises* from the anterior edge of the tibia, and is *inserted* into the upper and outer part of the astragalus. The knee, elbow, and ankle joints, unlike those of the hip and shoulder, have no proper fibrous capsular ligament, independent of the synovial membrane.

Articulation of the Tarsus. The astragalus is attached to the os calcis by two articulating surfaces, each of which is furnished with a synovial membrane; between these is a dense *inter-osseous ligament*; there is also a *posterior ligament*, which is attached to the adjoining surfaces of the two bones; the head of the astragalus is articulated to the navicular bone, the end of the os calcis is also connected to the latter by a strong fibro cartilaginous substance called *calceo navicular ligament;* this extends from the inferior surface of the os calcis to the inferior part of the navicular, though not attached to the astragalus, it supports it, and completes the cavity for receiving its head; this ligament is strengthened by the tendon of the tibialis posticus, which in this situation frequently contains a sesamoid bone or cartilage. A thin broad ligament above also connects the astragalus to the navicular. The os calcis is attached to the cuboid by a synovial membrane and superior and inferior ligaments; the latter is very strong, radiated anteriorly, and attached to the third and fourth metatarsal bones. This articulation is exactly opposite to that between the astragalus and navicular bone; the opposite sides of the cuboid and navculiar bones are connected by ligaments and sometimes by synovial membrane. The three cuneiform bones are attached to the navicular by a synovial membrane which also extends between these; they are all secured by superior and inferior transverse and oblique ligamentous bands. The metatarsal bones are secured to the tarsus and to each other by dorsal and plantar ligaments: the three internal are articulated to the cuneiform bones, and the two external to the cuboid bones; all the metatarsal bones are also articulated to each other posteriorly by synovial membranes, except the first and second; the anterior end of each metatarsal bone is connected to the first phalanx, and the phalanges to each other by synovial membranes and lateral ligaments as in the upper extremity.

PART V.

DESCRIPTION OF THE BONES.

The osseous structure is the hardest in the body; it is composed chiefly of phosphate of lime, with a little carbonate deposited in a cartilaginous substance which is perfectly organized and well supplied with vessels for its nourishment and growth. The bones present great variety of figure; they are commonly classed into the *flat*, *long*, and *irregular*. They support and protect the soft parts, give the general form to the whole body as well as to its different parts, they also serve as the passive organs of locomotion, affording a series of levers by means of which the muscles effect the various motions and actions of the body.

When all the bones are connected by their ligaments, the collection is called a *natural skeleton;* when united by art, an *artificial skeleton.* The skeleton is divided into the trunk and extremities.

The *trunk* consists of the middle part and two extremities; the middle of the trunk is formed by the vertebral column and the chest; the upper extremity of the trunk is the head, the lower the pelvis.

The *vertebral column* consists of twenty-four vertebræ, which are divided into three classes according to the three regions, viz. seven cervical, twelve dorsal, and five lumbar.

The *chest* or *thorax* is formed before by the sternum, which consists of two or three pieces, on either side by the twelve ribs, and behind by the dorsal vertebræ.

The *head* comprises the cranium and the face: the *cranium* or *skull*, is composed of the frontal, the two temporal, two parietal, the occipital, the ethmoid and the sphenoid bones; to these may be added the small turbinated bones of the sphenoid or of Bertin, and the four auricular bones in each temporal bone, which have been already described in the anatomy of the ear.

The *face* is divided into the upper and lower jaw; the *upper* consists of the two superior maxillary, two palatine, two lachrymal, two nasal, two malar, two inferior turbinated bones and the vomer; to these may be added the sixteen teeth. The *lower jaw* consists of the inferior maxillary bone, which contains sixteen teeth; some consider the os hyoides as an appendix to the bones of the face; this bone however has been already noticed in the description of the larynx.

The *pelvis* is the lower extremity of the trunk; it consists of the sacrum, the coccyx, and the two ossa innominata.

The *superior* or *thoraccic extremities* are composed each of four parts, the shoulder, which consists of the clavicle and scapula; the arm, of the humerus; the fore-arm of the radius and ulna; and the hand, which is subdivided into the carpus, matacarpus, and fingers. The carpus consists of eight small

bones; the metacarpus of five, and the fingers each of three phalanges except the thumb, which has only two.

The *inferior* or *abdominal extremities* are each divided into three parts; the thigh, which consists of but one bone, the femur; the leg, which consists of three, the patella, tibia, and fibula; and the foot, which is divided into three parts, the tarsus, metatarsus, and toes; the tarsus consists of seven irregular bones, the metatarsus of five long bones, and the toes of the three phalanges each, except the great toe, which has only two. In the adult skeleton the number of bones amount to 242, including the bones of the ear and the teeth, but excluding the os hyoides and the sesamoid bones.

THE VERTEBRÆ.

The *Vertebræ* are twenty-four in number, they belong to the class of irregular bones, are placed one above the other, and connected by ligaments so as to form one solid, yet flexible column, placed in the middle and back part of the trunk, and extending from the head to the sacrum. All the vertebræ agree in the general outline, which is as follows; each vertebra consists of a body and of several projections or processes: the *body* occupies the anterior central part; it is thick and spongy, and rather circular or oval; its flat surfaces above and below give attachment to the intervertebral ligaments; the margin of each is tipped with a compact white substance; anteriorly it is transversely convex and very porous, posteriorly concave, so as to form part of the spinal canal of foramen; this surface is perforated by several holes for vessels. The processes of each vertebra are nine, two lateral or the laminæ, two transverse, four oblique or articulating, and one spinous.

The *lateral processes* or *laminæ*, arise, one on each side by a sort of pedicle from the posterior part of the body; they pass backwards, bounding the sides of the spinal hole, and unite posteriorly in the spinous process; they are broad behind, but narrow where they join the body, being grooved out above and below into a notch; the inferior of these is the larger; these *notches*, when the vertebræ are joined, form the intervertebral holes for the passage of the spinal nerves. The *spinous process* is the most projecting part of the vertebra in the posterior median line; its base is bifurcated, its apex generally ends in a point or tubercle. The *tranverse processes* arise from the laminæ, and are directed outwards on each side. The *articular* or *oblique processes* arise from the roots of the transverse, two ascend, two descend; they are covered with cartilage, and articulate with the corresponding processes of the vertebra above and below. The *spinal hole* or *canal* is bounded by the body and processes; it is oval or triangular. The processes of the vertebræ are of a more compact structure than the bodies, which are very light and spongy. A vertebra is generally developed by three points of bone, one for the body, and one on each side for the laminæ and articulating processes; sometimes a fourth point is deposited for the spinous; this process is seldom found ossified in the fœtus, but remains cartilaginous for some time. In addition to these three principal ossific points, there are frequently accessary points or epiphyses found in the processes, as well as on the surfaces of the body. These are the general characters of all the vertebræ, but each of the three classes present some peculiarity.

The *lumbar vertebræ* are five; these are the largest in the column; the *body* of each is very broad transversely, compared with its height; its upper and lower surfaces are flat, and bordered with hard projecting edges, which render it concave from above downwards on its fore-part. The *laminæ* are thick, broad, but short; the *notches*, particularly the lower, are very large; the *spinous process* is broad, flat, and square, and ends not in a point, but in a thick, rough border; the *articulating processes* are oval, strong, and vertical: the superior are concave and look inwards; the inferior are convex and look outwards; the *transverse processes* are long, thin, and horizontal, and more anterior than those of the dorsal vertebræ; the spinal foramen is triangular, and larger than in the back; the body of the 5th lumbar vertebra is cut off obliquely below, so as to be much thicker before than behind; its transverse processes are short, strong, and rounded.

The *dorsal vertebræ* are twelve in number, and of an intermediate size between the cervical and lumbar; they decrease from the 1st to the 4th, and then increase to the last, so that the 4th and 5th are the smallest. The *body* is thicker behind than before, and longer from before backwards than transversely, flap above and below and round, except in the 1st, whose surfaces are heart shaped, and very convex anteriorly; on either side it presents two small depressions or notches, covered with cartilage; the superior is the larger; when the vertebræ are conjoined two of these notches form an oval depression for the head of each rib; the *laminæ* are broad and thick; the *notches* are large and anterior to the oblique processes; *the transverse processes* are long and large, and directed backwards: on the front of each near the end except of the last two, there is a small depression covered with cartilage, for articulating with the tubercle of the rib; the *oblique processes* are vertical, the superior directed backwards, the inferior forwards; the *spinal hole* or canal is small and oval; the *spinous processes* are long, of a prismatic or triangular form, bent downwards very much, or imbricated, and tubercular at their extremities. The 1st has the body long transversely, and on either side a full depression above for the head of the 1st rib, and half of a similar cavity below for the upper part of the head of the second rib; its spinous process is thick, long, and horizontal, and its articular processes are oblique: the 10th has also a full depression for the 10th rib, the 11th and 12th in like manner; these also want the articulating depressions on the transverse processes; the 12th also resembles the lumbar, in the shape of its body, and inferior articular processes.

The *cervical vertebræ* are seven in number and smaller than the others; their *body* is long transversely, a little deeper before than behind; the lower surface is concave from behind forwards, the upper is larger or broader, and concave from side to side; the structure is more compact than in the dorsal and lumbar; the *laminæ* are long and narrow, sharp and small superiorly, round and large inferiorly, so as to overlap those below; the *spinal hole* is large and triangular; the *notches* are small and anterior to the articular processes; they are nearly of equal size above and below; the *spinous process* is short, horizontal and bifid; the *transverse process* is short, bifid, grooved above for the nerves, and perforated near its base by a round hole for the vertebral vessels; it is on a plane anterior to the transverse processes of the

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back or loins, and appears, on account of its foramen, to have a second or anterior root from the body of the vertebra: the *articular processes* are oblique, the superior oval, slightly convex, look upwards and backwards; the inferior also oval, are concave, and directed downwards and forwards.

The 1st cervical vertebra or *atlas* differs from the remaining, in having a mere bony ring, without any distinct body or spinous process, the anterior part of this ring is tubercular before, but presents posteriorly a smooth and concave oval articulating surface which receives the odontoid process of the 2d vertebra: the margin of this ring gives attachment to ligaments; it is round and thick behind, with a tubercle, instead of spine for the attachment of the recti muscles; the *spinal hole* is very large and divided into two by the transverse ligament, which arises from two tubercles placed on the inner side of the superior articulating processes; the anterior portion, small, receives the tooth-like process of the 2d vertebra, the posterior forms the spinal canal, the *laminæ* are thick and round behind, but, near the articulating processes, are grooved above for the vertebral artery, and below for the 2d spinal nerve; before these notches are the *articular processes*, the superior horizontal, concave, oval from before backwards, look upwards and inwards, and receive the occipital condyles; the inferior are nearly flat, circular, and inclined a little inwards; the *transverse processes* are long, and end in an obtuse point, the anterior root is slender, the posterior is long and large, the hole between these is larger than in the other vertebræ, and is directed upwards and backwards; from this a groove for the vertebral artery winds backwards round the superior articular process. In the adult the atlas is very compact; in the fœtus its ossification takes place from five points, one for the anterior arch, two for the posterior, and one for each lateral part.

The *axis* or 2d vertebra is remarkable for the length of its *body*, which has anteriorly a central ridge between two depressions for muscles, and from its upper part there rises by a sort of a neck, a large, round, dentiform (*odontoid*) process, the fore-part of which is received into the small articulating cavity on the anterior arch of the atlas, while posteriorly it presents a small, smooth convexity, which moves against the smooth surface of the transverse ligament of the atlas; the apex is rather pointed, to it and to the sides of this process the lateral or check ligaments are attached; the *laminæ* are very strong; the superior *notches* are behind, the inferior before the articular processes; the *spinal hole* is large and heart-shaped; the *spinous process* is forked and very strong, its under surface is channelled; the superior *oblique processes* are slightly convex, nearly horizontal, and look a little outwards; the inferior are smaller, flat, and look downwards and forwards; the *transverse processes* are short, arise from the outside of the superior articular processes, are bent downwards, and are not bifid; the hole is directed obliquely upwards and outwards. This vertebra in the fœtus has an additional point of ossification in the odontoid process. It is articulated directly with the atlas and the 3d vertebra, and indirectly with the occipital bone.

The *seventh* cervical vertebra is large, its spine is very prominent, and not bifid; its transverse process is seldom perforated, as in the other cervical vertebræ; when there is a foramen in it, it transmits the vertebral vein and not the artery; in this vertebra an additional point of ossification is found

in the pedicle which connects the processes to the body; this sometimes increases beyond the transverse process, so as to resemble a supernumerary or a cervical rib.

The length of the vertebral column is generally about a third of that of the whole body; the lumbar and cervical regions are nearly equal, and each about half the length of the dorsal, the latter commonly measures 12 inches, and each of the former about 6. Its general form is that of a pyramid, the base below; but when accurately examined it will be found to represent three pyramids; the first has its apex in the third cervical vertebra, surmounted by the axis and atlas, and its base is in the first dorsal, which is also the base of the second pyramid whose apex is in the fifth dorsal, where also is the apex of the third pyramid, whose base is at the sacrum; the vertebræ diminishing in size about the 4th and 5th dorsal. The column is convex anteriorly in the neck, concave in the back, and convex in the loins; these curvatures are caused by the different thickness of the bodies of the vertebræ before and behind; and of the intervertebral ligaments in these three situations. A perpendicular line passed through the centre of the apex and base of the column will be found anterior to the dorsal, and posterior to the cervical and lumbar vertebræ. In the dorsal region there is generally a lateral curvature also, which is usually concave to the left side; this direction of this curve has been by some ascribed to the pressure of the aorta on the left side, by others, and with more probability, to the effect of muscular action, for as the muscles of the right arm are the most used, the points of the spine to which these are attached will be drawn towards that side; in the several violent exertions also, such as pulling forcibly, the body is usually bent to the left side. The column is covered anteriorly by the anterior common ligament, and in the neck by the recti and longi muscles, in the back by the vena azygos and aorta, and in the loins by the crura of the diaphragm, the aorta, vena cava, and sympathetic nerves; posteriorly the column presents in the median line, the spinous processes short, horizontal, and separate in the cervical and lumbar, but close and bent over one another in the dorsal region; on each side of these are the vertebral grooves, which are wide in the neck, but deep and narrow in the back and loins; these are filled by the extensor muscles: the apertures between the laminæ are closed by the yellow ligaments, and covered by these muscles; outside these grooves in the neck and loins lie the oblique or articular processes, but in the back the transverse processes, which in this region are on a plane posterior to those in the neck and loins: the intervertebral or the holes of conjunction in the dorsal and lumbar regions are before the transverse processes, but in the neck between them; in the back they are behind the cavities for the heads of the ribs. The spine supports the head and chest, and combines strength with lightness and flexibility; it serves as the centre of all the motions of the trunk, and transmits the weight it bears to the sacrum and pelvis; it gives insertion to numerous muscles, and lodges and protects the medulla spinalis in the spinal canal; this canal is large and triangular in the neck and loins, round and contracted in the back. The spinal column is nearly straight or perpendicular in the child; in the fœtus the pyramidal figure is reversed, the base being in the cervical and dorsal vertebræ, the apex in the lumbar and sacral.

THE THORAX OR CHEST.

Is formed by the 12 dorsal vertebræ, already described, by the sternum and 12 pair of ribs.

The *Sternum* is situated at the forepart of the chest, in the median line, and in a direction from above downwards and forwards; of a flat and elongated form, broad above, narrow in the middle, and pointed below; its anterior surface is covered by the skin and pectoral aponeurosis, is marked by four transverse lines which indicate its original division into five pieces; the two upper lines are most prominent; the posterior surface is smooth and concave, gives attachment to muscles, and looks toward the anterior mediastinum; the edges are thick, and present seven depressions for the cartilages of the true ribs; the superior of these is round, and the margin of it is often continuous with the 1st costal cartilage; the remaining depressions are angular, and most of them correspond to the transverse lines or ridges; hence these sockets are more distinct in the young than in the old; they are all covered with cartilage and separated from each other by notches. The upper or clavicular end of the sternum is broad, thick, and concave from side to side, for the lodgment of the interclavicular ligament, and is hollowed out at each angle for articulation with the clavicle, into a shallow sigmoid cavity covered with cartilage and directed outwards and backwards; this surface is slightly convex from before backwards; the inferior extremity is long and thin, and ends in a cartilaginous epiphysis, the *xiphoid* or *ensiform cartilage;* this is sometimes pointed, sometimes bifid, thick or thin, turned forwards or backwards, and sometimes perforated by a central hole; it remains cartilaginous to a late period of life; to it the abdominal muscles and the costo-xiphoid ligament are attached. The sternum in the fœtus is separable into four or five pieces, in the adult into two The upper piece is the larger and thicker of the two, and somewhat square, its edges receive the cartilages of the 1st rib, and half of those of the second; its lower edge is nearly straight, and united to the 2nd piece by a cartilage which sometimes admits of slight motion between the two, but which in old persons is generally found ossified: a foramen is sometimes observed in this piece of the sternum. The 2nd piece is longer and narrower than the first, its edges are marked by five depressions for the five lower true costal cartilages, and at its superior angle by half a notch, which joined to a similar notch in the first piece, formed the cavity for the 2nd cartilage; the five lower notches approximate, and the last is frequently completed by the xiphoid cartilage. This bone consists of a very spongy, cellular, and vascular tissue, covered on each surface by a compact layer.

The *Ribs* are twelve on each side; they extend in an arched manner from the vertebræ towards the sternum, to which the seven superior are attached by separate cartilages; these are the *true* or the sternal ribs; the five inferior do not form complete circles, and are connected anteriorly to each other, and to the cartilage of the last true rib, and are named *false;* the two last of these are sometimes called the *floating* ribs; the length of the ribs gradually increases from the 1st to the 8th, and then diminishes to the last; the breadth gradually diminishes from the 1st to the 12th, but in each rib it is greatest near the sternum; the 1st is nearly horizontal, the succeeding gradually incline

downwards, so as to be lower before than behind; the external surface of each is convex and smooth, and gives attachment to different muscles; the internal is concave, and lined by the pleura; the upper border is round and smooth, and gives attachment to the intercostal muscles; the inferior is thin, and marked with a groove, which is deep posteriorly for the intercostal vessels; this also gives attachment to the intercostal muscles. The posterior end of the rib presents a head, neck, and tuberosity; the *head* is round, and divided by a ridge into two articular surfaces, which are received into the depressions in the dorsal vertebræ; an intervertebral ligament is attached to the middle ridge. The head is supported by the *neck*, which is narrow and round, and lies in front of the transverse process, to which it is connected posteriorly by the middle costo-transverse ligament. Beyond the neck is the *tubercle*, which looks backwards and downwards, and is divided into two portions: the internal of these is smooth for articulation, with the transverse process of the inferior of the two vertebræ, to whose bodies the head of the rib is connected; the outer portion is rough for the insertion of the external or posterior costo-transverse ligament. External to the tubercle is a rough line, which marks the turn or *angle* of the rib; this ridge gives insertion to the tendon of the sacro-lumbalis muscle; it descends obliquely forwards; it is close to the tubercle on the 1st, but the distance between these increases in the succeeding ribs to the 11th; the angle is not distinct on the 12th. The anterior or *sternal end* is thin, broad, and hollowed into an oval pit for the insertion of the costal cartilage. The 1st rib is short, broad, nearer the axis of the chest than the others, has no angle, and therefore is not twisted, but represents nearly a horizontal semicircle; its external surface is directed upwards, and is marked by two grooves for the subclavian vein and artery, into the intervening ridge the anterior scalenus muscle is inserted; the head of this rib is undivided, there is no groove, the sternal end is very strong; the 11th rib has no groove or tubercle, its head is also undivided; the 12th has neither angle, tubercle, or groove, and is very short. The ribs are formed of a cellular structure covered by compact and strong laminæ, which often present a scaly appearance; they are hard and elastic. In the fœtus each rib presents three points of ossification, one for the head, another for the tubercle, and the third for the body or shaft.

The *Costal Cartilages* are twelve in number; the 1st is very broad but short, the length increases in the succeeding to the seventh, and then decreases to the last; the 1st descends a little, the 2d is nearly horizontal, the succeeding ascend more and more; the costal end of each is convex, and implanted in the rib; the sternal end of the seven superior in the sternum, those of the three superior false, are blended together, and those of the two last are pointed and unattached. The costal cartilages are the strongest and longest in the body; they are flexible and elastic, and have a great tendency, particularly the four or five superior, to ossification; they then become opaque and very compact; in their natural state they appear destitute of vessels, nerves, or any organic texture, but are enveloped by a vascular membrane.

The *Thorax*, composed of the foregoing bones and cartilages, resembles a truncated cone, the base below, the apex above, flattened before and behind; in some from the effect of dress, it is of an ovoid form, being contracted at the lower part and wide in the middle; the anterior wall leads obliquely downwards

and forwards, and is shorter than the posterior, which is more vertical, and rendered very irregular by the vertebral grooves, and the angles of the ribs; the sides are convex, particularly behind; the intercostal spaces are short, but wide above, long and narrow in the middle, and again short below; they are broader before than behind. The apex is small, transversely oval, and very oblique from behind forwards and downwards; it is bounded by the first ribs, sternum and vertebral column; the trachea, œsophagus, and the cervical vessels and nerves pass through it; the base is very large, also transversely oval, and very oblique from before backwards and downwards, it is bounded by the xiphoid cartilage, the conjoined cartilages of the false ribs, and the vertebral column; it presents a great notch anteriorly, in which the xiphoid cartilage is, and posteriorly a small notch on each side for the vertebral column. The axis of the chest is oblique from above downwards and forwards, in consequence of the oblique direction of the sternum, hence if a line be made to ascend perpendicularly from the base, it will pierce the upper part of the sternum; and not pass through the apex of the cavity. The dimensions, and even the form of the chest, vary in different individuals and at different ages.

THE PELVIS.

The *Pelvis* is the deep circular cavity at the lower end of the trunk, bounded by the sacrum, coccyx, and two ossa innominata; the latter in the young subject can be separated each into three, the ilium, ischium, and pubis.

The *Sacrum*, in the erect position of the body, is placed at the upper and back part of the pelvis between the last lumbar vertebra above, the coccyx below, and the ossa innominata on either side; of a triangular form, the base resembles a vertebra, looks upwards and forwards, is very broad transversely, and presents in the middle an oval surface or body cut off obliquely from before backwards and upwards, and covered with cartilage for articulation with the last lumbar vertebra, its anterior edge is named the promontory; behind this is the triangular aperture of the sacral or spinal canal, and on each side of it is a smooth convex surface (or transverse process) directed forwards and continuous with the iliac fossæ; on either side of the spinal hole is the oblique or articular process, concave and looking backwards and inwards to receive the articular processes of the last lumbar vertebra; anterior to each is a groove, which contributes with the notch in the last vertebra to form the last of the holes of conjunction for the passage of the last of the lumbar spinal nerves, and behind the oblique processes are the laminæ, which are sharp, and give attachment to the last of the ligamenta flava. The inferior extremity or apex is directed downwards, and presents a small oval convex surface to articulate with the coccyx, on each side of which is a small notch for the last sacral nerve; the anterior surface is concave from above downwards, flat from side to side, marked by four transverve lines, which indicate its original division into five pieces resembling so many vertebræ (hence sometimes called false vertebræ;) the first of these grooves is convex, the remaining are concave; on either side of the median line are the four anterior sacral holes, the two upper large, the two lower small; they are all round and smooth, communicate with the sacral canal, and transmit the anterior

sacral nerves; grooves lead outwards from these holes, along which the nerves run; these are analogous to the intervertebral holes, and the intermediate grooved bone to the transverse processes in the vertebral column above; external to these is a depressed surface, which gives attachment to the pyriform muscle. The posterior or spinal surface is convex and very rough, presenting in the median line four horizontal eminences analogous to the spinous processes, which are often united into one ridge; inferior to these the sacral canal ends in a triangular channel, which is only closed behind by ligament and bounded on each side by two tubercles or cornua, beneath which is a notch for the last of the sacral nerves; these cornua are sometimes joined to the base of the coccyx; at either side of the median spine are the four posterior holes, smaller and more irregularly formed than the anterior; they transmit the posterior sacral nerves; external to these are a range of tubercles analogous to the oblique processes; the sides or iliac surfaces are uneven, triangular, broad above, and consisting of two portions, one superior, broad, and irregular, covered with cartilage for articulation with the ilium; the other inferior, thin, and attached to the sacro-sciatic ligaments. The sacrum, though very thick, is yet light and spongy and covered by a thin lamina of compact substance; it is long and narrow in the male, broad and short and more curved in the female; in the latter it is about four inches and a half long, its breadth above is nearly the same, but below only half an inch; in the fœtus it is nearly straight, and consists of five pieces, in each of which ossification commences in several points.

The *Coccyx*, placed at the extremity of the sacrum, is formed of three or four pieces, which in the old are united into one or two, but in the young are always distinct; in the adult it is triangular, and prolongs the curve of the sacrum anteriorly, the base is above, with a smooth oval surface adapted to the sacrum, and on either side of this is a small horn or process which is also connected to the sacrum by bone or ligament; beneath this is a notch for the last sacral nerve; the apex is irregularly tubercular, and gives attachment to the muscles of the rectum; the anterior or pelvic surface is smooth, supports the rectum, and is marked by two or three transverse lines, which indicate its original division into distinct pieces; the posterior or spinal surface is rough for the attachment of muscles; it is soft and spongy, its ossification commences by four or five points, it becomes united to the sacrum earlier in the male than in the female.

OSSA INNOMINATA.

As each os innominatum is divisible in early life into three bones, the ilium, ischium, and pubis, it will be found more convenient to describe each of these separately, in preference to considering the os innominatum as a single bone, which however it really becomes after puberty.

The *os ilium* is situated at the upper and outer part of the pelvis, and forms that projection commonly called the hip; it is broad, flat, and triangular, the base above, and semicircular, the apex below forming the upper and outer part of the acetabulum; it may be divided into the body, alæ, and processes. The *body* is the inferior constricted portion which presents three surfaces, one external, smooth and concave, forms the upper and outer side of the

acetabulum; the second is anterior, small, triangular, and united to the pubis; the third is posterior and joined to the ischium. The *ala* is the broad fan-like portion which ascends, inclines outwards and a little forwards; its external surface or dorsum is irregularly convex, rough, and marked by two curved lines from which the glutæus medius and minimus arise; above and behind the upper line the bone is rough for the origin of the glutæus maximus; the internal surface of the ala is divided into three part; one superior and anterior, is the iliac fossa, which gives origin to the internal iliac muscle. the second is posterior, rough, and united to the sacrum, and the third is smooth and small, and is the only portion of the ilium that enters into the side of the true pelvis, this pelvic portion of the ilium is above the sciatic notch, and is separated from the fossa by an obtuse ridge which is continuous behind with the promonotary of the sacrum, and before with a similar ridge of the pubis; this line is named ilio-pectinea, and into the iliac portion of it the tendon of the psoas parvus and the iliac fascia are inserted. The *processes* are, first the *crest*, which in the young subject is an epiphysis, it forms the upper border of the ala, it is curved inwards before and outwards behind, and gives attachment to the three layers of abdominal muscles. Second *anterior superior spine*, is that prominent projection at the upper and fore-part of the crest and ala, it gives attachment to the muscles and to Poupart's ligament, between this and the next process is a notch; third, *inferior spine* is above the outer part of the acetabulum, it gives attachment to one head of the rectus femoris muscle; the notch between these two spinous processes is filled by the sartorius and iliacus muscles; internal to the inferior spine is a superficial groove along which the psoas and iliac muscles pass; this groove is bounded internally by the ileo-pectinæal eminence, which is common to the ilium and pubis; fourth, the *posterior superior spine* is the posterior termination of the crest, below which is a notch; and fifth, the *posterior inferior spine;* these two processes give attachment to ligaments and muscles, beneath the inferior is the commencement of the sacro-sciatic notch.

The *Ischium* is placed at the lower, outer, and back part of the pelvis, and presents a body and processes: the *body* forms the outer and back part of the acetabulum, more than two-fifths of which it forms, and presents a prominent line or border; beneath this is a horizontal groove, which lodges the tendon of the obturator externus, and from this a rough ridge leads down to the tuber of the bone and gives attachment to the quadratus femoris muscle; the anterior part is thin and sharp, and bounds the thyroid hole; the posterior part joins the ilium, and bounds the sacro-sciatic notch. The processes are, first the *spine*, which arises from its posterior part just below the notch; it projects backwards and inwards, gives attachment to the superior gemellus and the lesser sciatic ligament, and bounds the great sciatic notch inferiorly; below the spinous process, between it and the following is the smooth pulley round which the tendon of the obturator internus muscle turns; 2d, the *tuberosity* is beneath this pulley and the lesser sacro-sciatic notch, on this process the body rests in the sitting posture, it is broad behind and covered with cartilage, it gives attachment to the adductor magnus and to the hamstring muscles: on its internal side is a groove for the tendon of the obturator externus; 3d, the *ramus* ascends from the tuber forwards and inwards, and joins that of the pubis; it is thin and flat, one border is thin and bounds the thyroid hole,

the other is thick and in part bounds the lower aperture of the pelvis, to it are attached the crus penis, and the compressor penis muscle.

The *Os Pubis* is situated at the forepart of the pelvis, and internal part of the acetabulum; it may be divided into its body and processes; the *body* is the most external, it is thick, and forms the internal and superior part of the acetabulum, above which it joins the ilium in the ilio-pectinæal eminence, and below it is united to the body of the ischium; from this the 1st process proceeds, the *horizontal ramus*, forwards and inwards, smooth and flat superiorly, and covered by the pectinæus, smooth also posteriorly towards the cavity of the pelvis, and grooved beneath for the obturator foramen; a sharp ridge separates its superior from its posterior surface; this ridge is the anterior part of the linea ileo-pectinæa, into it the pectinæus muscle and Gimbernaut's ligament are inserted; at the internal extremity of this ramus and of this line is the 2nd process, the *tuberosity* or *spine;* this is a prominent tubercle into which Poupart's ligament is inserted; from this spine the 3rd process, the *crest*, leads transversely inwards; it is about an inch in length; the rectus abdominis and pyramidalis muscles arise from it; at its internal end is the 4th process, the *symphisis;* this descends nearly vertical, and is joined to the opposite one by an intervening cartilage; as the symphisis turns down from the transverse crest there is the *angle* of the pubis; from the lower part of the symphisis descends the 5th process, the *inferior* or *descending ramus* in an oblique direction backwards and outwards, to meet the ramus of the ischium; this, with the ramus of the opposite pubis, forms the *arch of the pubis*, its outer edge assists in bounding the thyroid hole.

The *Acetabulum* or articular cavity for the head of the thigh bone is formed by the junction of the bodies of these three bones in different proportions; the ischium constitutes a little more than two-fifths, the ilium somewhat less than two-fifths, and the pubis the remainder; it is surrounded by a prominence which is deficient or notched at only one point, this notch in the border is opposite the thyroid hole, and between the ischium and pubis, through it the articular vessels pass; a rough surface, the only part uncovered by cartilage, leads from it to the centre of the cavity; to this the articular ligament and a quantity of adipose membrane are connected; this cotyloid cavity looks outwards, downwards, and forwards, the upper and outer portion, by which the weight is transmitted to the thigh, is the deepest, it is shallow at the lower and internal part.

The *Pelvis*, which is thus made up of the ossa innominata, the sacrum, and coccyx, may next be examined on its external and internal surface; anteriorly and externally it presents the symphisis and crests of the pubes; the ileo-pectinæal eminences, and beneath these the acetabula and the thyroid holes, more laterally is the dorsum of the ilium, marked by its curved lines, posteriorly the sacral spines occupy the median line; external to these are the sacral foramina, beyond which is a rough surface for the attachment of ligaments and muscles; and lastly the great sacro-sciatic notch, which is bounded by the sacrum, ilium, and ischium. The *superior* circumference or *base* of the pelvis, is inclined upwards and forwards, is formed on each side by the crest of the ilium, posteriorly by the promontory of the sacrum, on each side of which is a deep notch, which is filled by muscles, anteriorly by the iliac

spines, ilio-pubal eminences, the intervening grooves, and by the ossa pubis; the *lower* or *perinæal* circumference or strait of the pelvis, is directed downwards and backwards, and bounded by the rami of the pubes, the rami and tubera ischii, and by the sacrum and coccyx, this strait presents three great notches: 1st, the arch of the pubis, triangular, and placed beneath the symphisis, the 2nd and 3rd are placed between the sacrum and os innominatum, very large in the dried bones, but in the recent state they are divided by the sciatic ligaments, each into two, the great or superior, the lesser or inferior sacro-sciatic notch; the former transmits the pyriform muscle, the glutæal, sciatic, and pudic vessels and nerves, the latter the tendon of the obturator muscle, and the pudic vessels and nerves. The internal surface of the pelvis is divided into two by the prominent line before mentioned, the linea ilio pectinæa, which leads from the spine of the pubis to the promontory of the sacrum, below this line is the *true* pelvis, above it is the *false* pelvis, which is rather a portion of the abdomen; this line is more distinct posteriorly than anteriorly; this abdominal or *upper strait* of the pelvis is somewhat elliptical, the greatest diameter being transverse; it is measured by four lines or diameters; 1st, the antero-posterior or sacro-pubic is smallest on account of the projection of the sacrum; 2nd, the transverse or iliac which crosses the 1st at right angles and is the greatest; 3d and 4th, the oblique which lead from one ilio sacral articulation to the opposite ilio pubal eminence, or the cotyloid wall. Above this strait the great or false pelvis expands and is deficient in bone anteriorly, being only closed by the abdominal muscles, Beneath this strait is the true pelvis, which is a sort of curved canal longer than the false pelvis and wider about the centre than at either strait, with smooth walls, concave posteriorly from above downwards, concave anteriorly in the transverse direction, and on either side nearly plane; the sacrum and coccyx bound it posteriorly, the pubes and thyroid foramina anteriorly, and on either side a portion of the ilium and ischium, the sciatic notches and ligaments. The pelvis is placed in an oblique direction, its upper orifice looking forwards, so that if a line be passed horizontally from the upper border of the symphises pubis backwards, it will meet the middle of the sacrum. The lower orifice looks backwards and downwards, the axis of the two orifices therefore is not the same, that of the superior if produced would pass anteriorly through the abdominal muscles, between the pubis and umbilicus, and posteriorly it would rest against the lower third of the sacrum; the axis of the lower strait if produced from below upwards would touch the promontory of the sacrum, these lines therefore will decussate near the centre of the pelvis and form an oblique angle forwards. The axis of the false pelvis is nearly vertical, while that of the true cavity is oblique from above and from before downwards and backwards. The *female pelvis* differs from the male in several circumstances, it is wider and larger, but not so deep, the alæ of the ilium are more expanded, the prominence of the sacrum is less, the upper strait is rounder and wider, the sacrum is broad and more concave, the pubic arch more round and open, the symphisis pubis is not so deep, the sciatic tuberosities are directed more outwards, and the acetabula are more distant from each other; the *male* pelvis is deeper, narrower, and stronger. The dimensions of the male and female pelvis are given by Meckel as follows, Tom. 1. p. 473.

	In the Male. Inches.	Lines.	In the Female. Inches.	Lines.
The transverse diameter of the great pelvis between the anterior superior spinous processes of the ilia, - - -	7	8	8	6
Distance between the cristæ of the ilea, - - -	8	3	9	4
Transverse diameter of the superior strait, - - -	4	6	5	0
Oblique do. of do. - - - -	4	5	4	5
Antero posterior do. of do. - - - -	4	0	4	4
Transverse diameter of the cavity, - - - -	4	0	4	8
Oblique do. of do. - - - -	5	0	5	4
Antero posterior do. of do. - - - -	5	0	4	8
Transverse diameter of the lower strait or outlet, - -	3	0	4	5
Antero posterior do. of do. - - - -	3	3	4	4

The latter may be increased to 5 inches, from the mobility of the coccyx

The ossa innominata are composed of two thin but compact laminæ with an intervening diploe, the latter is nearly wanting in the iliac fossa where the bone is transparent, as well as in the cotyloid cavity. In the fœtus each os innominatum is developed from three points of ossification, one in the iliac fossa, one in the sciatic tubercle, and one near the spine of the pubis; these three soon unite in the cotyloid cavity. Some years after birth the iliac crest is developed as a distinct epiphysis, the sciatic tubercle and anterior inferior spine of the ilium are also covered by distinct plates of bone, and in some the angle of the pubis; in some females also, a plate of bone or epiphysis constitutes the spine of the pubis and occasionally grows so large and remains so movable, as to resemble the rudiments of a marsupial bone. In the fœtus, the pelvis is very small and deep, and narrow transversely; the true and false are nearly in the same line, the acetabula are nearer the middle line and look more outwards, they are not beneath the pelvis as in the adult, hence the thigh bones in the infant cannot support or balance the weight of the trunk.

THE HEAD.

THE *Head* stands at the upper extremity of the vertebral column, is of a spheroid figure, compressed on the sides; it contains the brain and the principal organs of sense, and is divided into the cranium and the face. The *cranium* or skull is of an oval figure, the narrow extremity before; it contains the brain, and is formed of eight bones, the frontal, two parietal, two temporal, the occipital, sphenoid and ethmoid; these bones are all closely united by sutures, in some of these are small bones called ossa triquetra or Wormii; the frontal is considered as common to the cranium and face, but the temporal, ethmoid, and sphenoid are equally entitled to this distinction. The anterior region of the skull is named synciput or forehead; the posterior, occiput; the lateral, the temples; the upper part the vertex or bregma; and the lower, the base. The frontal, occipital, ethmoid and sphenoid bones occupy the median line, the others are lateral, and symmetrical, even the single bones are composed of parts perfectly similar on each side of the median line.

The *Frontal Bone* at the upper and anterior part of the skull, forms the forehead, part of the temples, of the orbits and nose; it is of a semicircular form, convex and smooth anteriorly, concave posteriorly, and irregular below, it may be divided into the *superior* or *frontal* portion, and the *inferior* or *orbital*; the external surface of the frontal part presents in the median line,

a longitudinal depression, in some not very distinct, in others there is an elevation; this corresponds to the line of union, of the two pieces of which the bone when young consisted, it is parallel to the longitudinal sinus internally, a suture frequently exists in it, particularly below; at the lower part of this line is the nasal prominence longer in the old than in the young; the bone here is frequently very porous, it terminates in a rough edge for articulation with the nasal and superior maxillary bones; from the centre of it projects the *nasal spine* or *process*, which supports the nasal bones before, and the ethmoid bone behind, on each side of this is a groove which forms part of the superior nasal fossæ. On either side of the median line of the frontal bone and proceeding from above downwards we observe, 1st, a smooth surface, covered by the occipito-frontalis muscle; 2d, the frontal eminence, which is particularly prominent in the young; beneath this a slight depression bounded below by the *superciliary arch* towards the inner third of which is the supra-orbital hole, or notch, which is completed into a hole by a ligament, and which transmits the supra-orbital nerve and vessels; from this notch a small foramen leads obliquely into the diploe of the bone; immediately above the internal third of this arch is the prominence of the frontal sinus, and below it is the edge of the orbit, at each extremity of which are the *angular processes;* the *external* is prominent and joins the malar bone, the *internal* is thin and broad and joins the unguis; above and outside the external is the *temporal* ridge or *process*, which is prominent below and leads upwards and backwards to join a similar ridge on the parietal bone, this separates the forehead from the temple and gives attachment to the temporal muscle and fascia. On the cerebral or internal surface of this portion of the frontal bone, we observe in the median line a groove for the longitudinal sinus; inferiorly the edges of this groove unite into a ridge to which the falx adheres, and which extends down to a small hole, the foramen cæcum, which is between this bone and the ethmoid; on either side of this median line are numerous irregularities, corresponding to the convolutions of the brain, in general, but not uniformly, for occasionally a prominent part of the bone is opposed to an eminence of the brain; these are named the mammillary eminences, and the digital impressions, in some of the latter the bone is often very thin. The circumference of the os frontis is thick, rough, and serrated to join the parietal bones; the tables are cut unequally, the external above, the internal below, so that it rests on each parietal above, and overlaps it below; below the temporal process it is bevelled off thin and rough, and is inserted under and between the laminæ of the ala of the sphenoid bone. The *inferior portion* of the frontal bone presents the deep æthmoidal notch in the centre, in front of which is the nasal spine and the orifices of the frontal sinuses, its edges are cellular to unite to and communicate with the cells of the ethmoid bone; along its margins are two foramina, the anterior and posterior orbital, they are common to this and to the ethmoid bone, the anterior transmits the nasal twig of the ophthalmic nerve and anterior ethmoidal artery, the posterior, the posterior ethmoidal artery; on either side are the *orbital processes* smooth, concave, and triangular, the apex behind, presenting near the external angular process a deep pit for the lachrymal gland, and near the internal a slight depression for the cartilaginous pulley of the superior oblique muscle of the eye, instead of a depression there is sometimes a small spine: the cerebral surface of these

processes is convex, but very uneven, marked by the brain and vessels; their posterior margins are thin, and cut obliquely to support the lesser wings of the sphenoid bone. The processes of this bone, enumerated by anatomists, are 11, viz., 2 orbital, 4 angular, 2 superciliary, 2 temporal, and 1 nasal; the foramina are 9, viz., 1, the foramen cœcum, 2 and 3, the frontal sinuses, between the nasal and internal angular processes, 4 and 5, the supraorbital, 6 and 7, the anterior, and 8 and 9, the posterior orbital; these last, as well as the foramen cœcum, are often common to this and the ethmoid bone. The os frontis is joined to 4 bones of the cranium, viz., the two parietal, the sphenoid and ethmoid, and to 8 bones of the face, viz., the nasal, superior maxillary, lachrymal, and malar. The structure is thick towards the nasal protuberance and superciliary ridges, but very thin in the orbital plates; it is composed of two compact laminæ and an intervening diploe, by the absorption of the latter and the greater separation of the plates, the cavities called the frontal sinuses are formed; these do not exist in childhood, and in the adult their extent is very variable; they generally extend from the ethmoid notch upwards and outwards for one third of the superciliary arch, sometimes much further; they are generally separated by a septum; their use is not fully ascertained. This bone is developed from two points of ossification, one in each frontal prominence; from this the bone extends in rays which unite in the middle line, but occasionally a suture remains between them; this has been said, but without sufficient foundation, to be more frequent in women than in men.

The *Parietal Bones* are symmetrical, and form the upper and lateral parts of the cranium; each is nearly square, convex, and smooth externally, about the centre is the protuberance, which is better marked in children, below this is the curved temporal ridge continuous with the process of that name on the os frontis, to this the temporal aponeurosis adheres; below this it is rough for the attachment of the temporal muscle; of the four edges, the upper or parietal is the longest, it is serrated, and with the opposite bone forms the sagittal suture; the anterior or frontal edge is also serrated to join the os frontis in the coronal suture; the posterior or occipital edge is very irregular, and joins the occipital bone in the lambdoid suture; in this suture small bones called ossa Wormii or triquetra are often found; the inferior or temporal edge is the shortest, it is concave, and joins the temporal bone by the squamous suture; of its four angles the anterior superior is nearly right, in the child this is deficient and the fontanelle exists; the superior posterior angle is somewhat rounded; near this in general is a foramen which transmits small vessels from the pericranium to the dura mater, the inferior anterior is long and curved and joins the sphenoid bone, the inferior posterior is very irregular and joins the mastoid portion of the temporal bone: the cerebral surface is marked by the convolutions of the brain, and by the branches of the middle artery of the dura mater; this vessel is in a groove, sometimes in a perfect canal or tube in the anterior inferior angle, and from this the branches pass upwards and backwards, a large one ascends a little posterior to the coronal edge; along the parietal border is half a groove, which, with that in the opposite bone, lodges the longitudinal sinus; near this are irregular depressions for the glandulæ Pacchioni or the granulations of the dura mater; the posterior inferior angle is grooved and lodges part of the lateral sinus: the structure of the parietal bone is similar to that of the frontal; it is developed from one point of

ossification, which is in the parietal prominence; it is joined to five bones, viz., the frontal, sphenoid, temporal, occipital and to its fellow.

The *Occipital Bone* is curved and of a rhomboidal figure placed at the posterior and inferior part of the cranium; it presents two surfaces, the external or posterior, or basilar, is convex, smooth above, presents near the centre the great *protuberance* to which the cervical ligament is connected; from each side of this leads the superior transverse ridge to which the occipito-frontalis, trapezius and complexus muscles are attached; midway between this and the foramen magnum, is the inferior transverse ridge, to which the splenii, recti majores and obliqui superiores are attached; from the tuberosity a spine leads down vertically in the median line as far as the foramen magnum; this latter is of an oval figure, and transmits the medulla spinalis, the vertebral vessels, and the suboccipital nerves; it is larger internally than externally; in front of this is the *basilar process* which is very thick and strong, it passes forwards and a little upwards into the base of the skull to join the sphenoid bone; its sides are rough and contiguous to the petrous bones; it is also rough inferiorly for the attachment of muscles and the mucous membrane of the pharynx; near the forepart of the foramen are the *condyles*, smooth and oblong, covered with cartilage, looking downwards, outwards, and backwards; their anterior and inner edges are the deepest, their long axis is from before backwards, in which direction, as also from side to side they are convex, they are uneven internally near their centre, for the insertion of the lateral ligaments from the odontoid process; they are articulated to the atlas; behind these is a fossa in which there is generally a small foramen through which a vein and small artery pass, and before them is another fossa in which there is always a foramen for the ninth pair of nerves; external to each condyle is the *jugular eminence*, semilunar, bounding posteriorly the foramen lacerum, and giving attachment to the rectus lateralis muscle. The upper angle is acute; the edges very irregular, as also along the sides, ossa triquetra are often entangled in the notches. The internal or cerebral surface is concave, and marked by two lines which cross about the centre or opposite the tuberosity, these bound four fossæ, the two superior receive the posterior lobes of the cerebrum, and are marked by their convolutions, the inferior are smooth, and lodge the hemispheres or the cerebellum, to the vertical ridge is attached the falx cerebri above and falx cerebelli below; the lower extremity of the latter is bifurcated, the upper half is grooved for the longitudinal sinus; to the transverse ridge the tentorium is attached, it is grooved for the lateral sinus; the basilar process is concave from side to side, to support the pons Varolii and the basilar artery; on either margin of it is a slight groove for the inferior petrosal sinus; on each side of the foramen magnum above the jugular processes is a groove for the lower extremity of the lateral sinus. This bone is joined to six bones, viz. the two parietal two temporal, the sphenoid and the atlas. Its processes are six, namely, two condyles, two jugular, the basilar, and the tuberosity. Its foramina are five proper and two common; the proper are, the magnum, the two anterior and two posterior condyloid; the common are, the foramina lacera postica basis cranii, these foramina are completed by the petrous bone, each is imperfectly divided into two, a small anterior portion which transmits the eight pair of nerves, and a larger posterior which lodges the termination of the lateral sinus in the commencement of the internal jugular vein. This is a very hard bone, although thin throughout except at the ridges

and processes; it is developed from four points, one for the basilar process, one for each condyle, and one for the upper and back part.

The *Temporal Bones* are situated at the lateral, middle and inferior parts of the skull, of a very irregular shape, thin above and before, and thick behind and below; each may be divided into three portions, the squamous, the mastoid, and the petrous. The *pars squamosa* is the superior division, it is flat, thin, and scaly, forms part of the temporal fossa, is bounded above by a semicircular edge, and below by the *zygomatic process*, which is horizontal and arises by two roots, one anterior covered by cartilage, narrow externally, broad internally, runs transversely in front of the glenoid cavity, the other passes horizontally backwards, and bifurcates, one portion turns into the glenoid fissure, the other is gradually lost above the mastoid process: where these two roots of the zygoma unite, there is a small tubercle to which the external lateral ligament of the lower jaw is attached; the zygoma thence bends forwards and downwards, slightly curved, convex outwards, and ends in a serrated edge which joins the malar bone: between the root of this process and the squamous plate there is a smooth trochlea, over which the posterior part of the temporal muscle moves; behind the transverse root of this process is the articular or glenoid cavity, which is crossed by the Glasserian fissure; this leads inwards and forwards, into it the capsular ligament is inserted, and near its centre is a small hole through which the chorda tympani nerve and the laxator tympani muscle pass; to this fissure also, the processus gracilis of the malleus is attached; the anterior part only of this cavity enters into the maxillary articulation, the posterior is filled by the parotid gland, and is bounded by the *auditory process;* this leads inwards and forwards behind the glenoid cavity from the external auditory hole, which is between the two divisions of the outer root of the zygoma; this process or meatus is a twisted plate of bone, united above to the squamous plate, but presenting below a rugged edge to which the cartilage of the ear is attached; the meatus takes a direction forwards, inwards, and a little downwards, it is wider about the centre than at the extremities, it leads to the membrana tympani. The squamous plate internally is marked by vessels and by the convolutions of the brain like the other bones of the cranium; its upper edge is bevelled off and is very rough to overlap the parietal bone. The *mammillary* or *mastoid* is the posterior inferior portion, it is joined to the parietal bone above, and to the occipital behind, by a very deeply serrated edge, inferiorly it is prolonged into a rough nipple-like process, the *mastoid*, internal to which is a groove for the occipital artery, and another partly behind it for the digastric muscle, above and behind it is a hole through which a vein and small artery pass; this process is hollowed out into cells which communicate with the tympanum, it gives attachment to the sterno-mastoid muscle; the cerebral surface is deeply grooved for the lateral sinus. The *petrous portion* passes from the junction of the mastoid and squamous forwards and inwards into the base of the skull, it is of a triangular form, the base behind and very irregular, with a deep notch which assists the occipital bone in forming the foramen lacerum posterius; the apex is anterior, contiguous to the body of the sphenoid bone, and completing with it, the foramen lacerum anterius which in the recent state is filled up with cartilage; this bone is peculiarly hard and rugged; on its inferior surface we remark in front of the foramen lacerum posterius a

minute hole which leads to the cochlea, and is named the aqueduct of the cochlea; more anteriorly is the *styloid process* which descends obliquely inwards and forwards, and gives attachment to three muscles; it is surrounded at its base or root by a plate of bone most prominent anteriorly and externally this is named the *vaginal process*, it separates the glenoid fossa from the carotid foramen: behind and outside the styloid process, between it and the mastoid, is the stylo-mastoid hole or the lower end of the aqueduct of Fallopius, this transmits the portio dura or the facial nerve; in front of the styloid process is the carotid hole which leads into a canal that winds forwards, upwards, and inwards, and which opens within the cranium above the foramen lacerum anterius by the side of the body of the sphenoid bone, it transmits the carotid artery and branches of the sympathetic nerve; in front of the carotid hole is a flat rough surface to which the muscles of the palate are attached; the apex of the petrous bone is very irregular, it lies in the foramen lacerum anterus, the internal opening of the carotid canal is in it; into the angle between the petrous and squamous portions the spinous part of the sphenoid bone is wedged; in this angle there are two holes separated by a thin lamina of bone, the upper transmits the tensor tympani muscle, the lower is the extremity of the bony part of the Eustachian tube. The superior or cerebral surface presents a prismatic form, a sharp angular ridge to which the tentorium cerebelli is attached, separates its two surfaces, one looks forwards and upwards, the other backwards and inwards; on the superior we observe anteriorly a slight depression which corresponds to the Casserian ganglion of the fifth pair of nerves; leading from this is a delicate groove which conducts to a small opening, the *hiatus Fallopii*, through which the superior branch of the vidal nerve passes in order to enter the aqueduct of Fallopius; the remainder of this surface is marked by the convolutions of the brain, and by the eminence of the superior semicircular canal; on the posterior surface is the *meatus auditorius internus*, through which pass the two portions of the seventh pair of nerves, it is directed forwards and outwards, is lined by dura mater, and is terminated abruptly by a vertical bony process, beneath which is a sort of cribriform plate, through this the auditory nerve pass, and above this the portio dura enters the aqueduct of Fallopius; the latter is a very long canal, which leads outwards and downwards behind the tympanum; the hiatus Fallopii and some canals from the tympanum open into it, it ends in the stylomastoid foramen; behind the meatus is a small depression lined by dura mater, and posterior to this is a narrow short slit in which the canal of the vestibule ends, from this slit a groove descends to the jugular opening.

The petrous bone contains within it the complicated apparatus of the organ of hearing which has been already described. The temporal bone is connected to five bones, the parietal, malar, sphenoid, occipital, and inferior maxillary, and in some to the os hyoides; in the fœtus it consists of two portions the squamous and petrous, the latter is large and well developed, and the ossicula auditus which it contains are perfect, and nearly as large as in the adult, the mastoid portion is not formed, the styloid process is cartilaginous, and is distinct from the rest of the bone, the external auditory meatus is wanting, a bony ring supplies its place and encircles the tympanum. The processes enumerated are five, viz. the mastoid, auditory, zygomatic, styloid, and vaginal; the holes are ten proper and two common; the proper are, the external auditory,

glenoidal, stylo-mastoid, mastoid, aqueductus cochleæ, carotid, Eustachian, hiatus Fallopii, internal auditory, and aqueductus vestibuli; the common are the foramen lacerum anticum, and posticum.

The *Æthmoid Bone* is situated in the notch between the orbital plates of the frontal bone, and forms the roof of the nostrils; it is so named from its cribriform or sieve-like appearance, it is of a cuboid figure, and composed of many thin, brittle, semi-transparent laminæ placed in every direction so as to form cells, these enlarge the surface of the nose without increasing the size or weight, for this bone is remarkably light; it consists of a middle perpendicular lamina and two symmetrical portions; its superior or cerebral surface is broad, and covered by the dura mater, in its posterior edge is a notch which receives a process of the sphenoid bone, along the middle line is a hard ridge, which anteriorly rises into a remarkable process, the *crista galli*, to which the beginning of the falx is attached, this process ends before in two short wings which join the os frontis, and which often assist in bounding the foramen cæcum; on either side of this process is a channel deeper before than behind, this lodges the olfactory nerves; anterior to each of these, and nearer to the process, is a small slit which transmits the nasal branch of the opthalmic nerve; this entire surface is perforated by numerous holes, about ten or twelve of these are large and are placed over the lateral parts of the bone, the remainder are very small and are on either side of the median line, they each lead into a small vertical canal lined by dura mater; from the inferior surface of this plate, there descends the nasal *lamella* in the middle and a large spongy cellular mass on either side; the *nasal lamella* is in the median line, it is thick above and behind where it joins the sphenoid, thin below where it joins the vomer and nasal cartilage, and very thick before where it unites to the nasal process of the os frontis and to the nasal bones, its sides are marked with the canals for the olfactory nerves, short and oblique before, vertical and very long in the middle and behind, they descend for about half the depth of the plate, and become converted into mere grooves; on either side of this septum is a deep channel, which forms the roof of each naris, on each side of this we observe an irregular long structure which consists of three parts, an internal curved lamina (the superior turbinated bone), a middle range of cells, and externally towards the orbit a smooth square plate, the os planum: the *turbinated* or *spongy bone* is a very thin plate descending at first vertically, and then bending outwards, and rolled upon itself for nearly half a turn; in this is a depression or sort of cleft, which is called the superior meatus of the nose, this channel or meatus extends along the posterior half of the æthmoid, it is closed before except in a small aperture which leads into the posterior æthmoid cells; the portion of the turbinated plate which extends below this fossa is named the *middle spongy bone*, it is larger than the upper portion, more curved and very concave outwardly, beneath this is a deep fossa named the middle meatus of the nose; the *æthmoid cells* are external to the turbinated plates, bounded above by the cribriform plate, and externally by the os planum, the cells are about twelve or fourteen in number, and are divided by a bony septum into an anterior and posterior set, the *posterior* are small, and open into the middle meatus, and sometimes one of the uppermost communicate with the sphenoid sinus or open into the fossa of its turbinated plate; the *anterior* cells are larger and more numerous, they open into the middle meatus,

one of the most anterior is curved into a sort of tube, the *infundibulum*, into this the frontal sinus opens above, and it terminates before the orifice of the great maxillary sinus or antrum; all these cells are lined by the pituitary membrane, which, however, is less vascular and thick than that on the nasal lamella or turbinated bones; on this membrane, particularly that covering the superior spongy bone, and the square surface before it, the external olfactory canals chiefly end; from the lower surface of the æthmoidal cells thin plates of bone often descend very irregularly to join the superior maxillary; external to the cells on each side is the *os planum* or orbital plate, very smooth and polished, articulated above to the frontal, before to the lachrymal, behind to the sphenoid, and below to the maxillary and palate bones, the upper border has often a notch or two which assist in forming the internal orbital holes. The æthmoid bone contributes to form the base of the cranium, the nose, and the orbits; it has little or no cellular tissue in its composition except in the turbinated plates and the crista galli; it is developed by three points of ossification, one for the central lamella and one for each side, the latter appear first, the turbinated plates are not distinct until five years of age: it is joined to two bones of the cranium, the frontal and sphenoid, and to eleven of the face, the nasal, superior maxillary, lachrymal, palate, inferior spongy, and the vomer.

The *Sphenoid Bone* is so named from the manner in which it is wedged into the base of the skull, in the middle of which it is placed, it is articulated to all the bones of the cranium, and to many of those of the face, it is of a very irregular form, and has been compared to a bat, to which it bears some resemblance, particularly if the æthmoid remain attached; it may be divided into a body and processes, the body is in the centre, and resembles a square box; from its median line inferiorly proceeds the *azygos process*, or the rostrum, which is received between the layers of the vomer, on each side of this is a small groove for vessels; the body is flat and rough posteriorly for attachment to the basilar process, anteriorly it presents the two small round openings of the sphenoid sinus, beneath which are often found two small triangular bones, the *spongy* or *turbinated bones* of the sphenoid, or of Bertin; the superior or cerebral surface of the body presents several remarkable appearances, it is hollowed from before backwards into the deep depression called sella turcica, this lodges the pituitary gland, and is perforated by several holes through which small vessels pass to the nose, posteriorly it is bounded by a thin plate which rises perpendicularly, and has a slight knob at each angle named the *posterior clinoid processes*, to each of these the extremity of the convex edge of the falx is attached, anterior to the sella is an eminence named the *olivary process*, on it is a transverse depression for the optic commissure, on each side of which are the *anterior clinoid processes*, two thick tubercles to which the extremity of the concave edge of the tentorium is attached, each of these is perforated by the optic foramen, which is transversely oval and transmits the opthalmic artery and the optic nerve; sometimes the anterior is united to the posterior clinoid process by bone, and sometimes to the olivary process, from each there extends forwards and outwards a thin plate of bone, the transverse spine or lesser wing, or wing of Ingrassius, this is united anteriorly to the frontal bone, and forms part of the orbit, it ends in a point, its posterior edge is thick and rounded, the sphenoidal fold of the dura mater is attached to it,

and both occupy the fissure of Sylvius on the base of the cerebrum between its anterior and middle lobes; each side of the sella turcica is grooved by the carotid artery; from its fore-part extends a small plate to join the æthmoid bone (*æthmoidal process*); from each side of the body the ala is continued outwards, forwards, and upwards; it presents three surfaces, one anterior smooth and square forms part of the outer wall of the orbit, and is named *orbital process*, another is elongated and concave, and together with the temporal bone supports the middle lobe of the cerebrum; the third or external surface is named the *temporal process*, this is divided into two by a crest, the upper part forms a portion of the temporal fossa, and the lower of the zygomatic fossa, some fibres of the temporal and external pterygoid muscles are attached to the crest itself; from the posterior part of each wing the *spinous process* extends backwards, and curves a little downwards and outwards, and occupies the angle between the squamous and petrous portions of the temporal bone, it terminates in a spine, the *styloid process*, on the inner side of the articulation of the lower jaw, near this process is a small foramen (*spinosum*) which transmits the middle or spinous artery of the dura mater, anterior to this is the *foramen ovale* opening directly downwards for the passage of the inferior maxillary nerve; still more anterior is the *foramen rotundum*, which leads forwards and transmits the superior maxillary nerve; between the lesser and great wing is a long slit, the *foramen lacerum orbitale*, wide internally, narrow externally where the frontal bone sometimes assists in closing it, it transmits the 3d, 4th, first branch of the 5th and the 6th pair of nerves from the cranium to the orbit; from the angle between the body and ala, the *pterygoid* plate descends perpendicularly, internally it bounds the posterior naris, externally the external pterygoid muscle is attached to it, anteriorly the palate bone is connected to it, posteriorly it is hollowed into the pterygoid fossa, which lodges the internal pterygoid muscle, and in a small depression internal to this the tensor *palati muscle;* this fossa thus divides this process into two plates, the *external* is broad and rough, the *internal* is longer and narrower, and ends in the *hamular* process, a small delicate hook, convex inwards, concave outwards, and covered by a bursa, round this the tendon of the tensor palati muscle turns; in the inferior notch between these plates the palate bone is received; above the internal pterygoid plate is the *vidian hole* or canal, this opens anteriorly on the inner side of the foramen rotundum, into the spheno-maxillary fossa, and posteriorly into the foramen lacerum anterius, it transmits the vidian nerve and vessels. The structure of the sphenoid bone is very compact, except the body which is cellular; the latter about ten years of age undergoes the process of absorption, whereby the cavities called the sphenoid sinuses are formed; these open into the upper and back part of the nose; in front of them in the adult is a small curved plate of bone, the *sphenoidal turbinated bone*, it is of a pyramidal form, the base anteriorly connected to the posterior æthmoid cells, the apex posteriorly, and joined to the fore-part of the sinus, it lies above the *spheno-palatine foramen*, a hole which is below the body of the sphenoid, and between the orbital processes of the palate bone; this hole leads from the nose to the spheno-maxillary space; these superior spongy bones are wanting in the child and sometimes in the adult. The sphenoid is articulated to the 7 bones of the cranium and to 5 of the face, viz., the two malar, two palate, and the vomer, and in some cases to the superior

maxillary by the pterygoid plates, the palate bones however in general intervene; the processes enumerated are 27, viz., 5 clinoid, 1 æthmoidal, 2 lesser wings, 1 vomer, 2 spongy or triangular, 2 great wings, 2 temporal, 2 orbital, 2 spinous, 2 styloid, 4 pterygoid, and 2 hamular: the foramina are 14 proper and 8 common; the proper are, 2 optic, 2 lacerated orbital, 2 round, 2 oval, 2 spinal, 2 vidian and the 2 sinuses; the common are, 2 foramina lacera antica basis cranii, 2 spheno-maxillary fissures, one in each orbit bounded by the orbital plates of the sphenoid, malar, maxillary and palate bones, 2 spheno-palatine, and 2 posterior palatine canals between the pterygoid processes and the superior maxillary tuberosities.

The bones of the cranium are connected to each other by *suture*, that is, the edge of each is serrated or cut into irregular teeth like processes, these indigitate or lock into each other, so as to unite the two edges in a very strong and motionless manner, the indentations are irregular and oblique in very thick bones, but where the edges are thin, the suture is more straight and regular, they are more distinct in the young than in the old, and on the outer than the inner surface of the cranium; there are seven sutures noticed by most anatomists, some however unnecessarily enumerate a greater number, the sphenoidal, æthmoidal, coronal, sagittal, lambdoid and two squamous. The *sphenoidal suture* is very extensive, it follows the irregular edge of the sphenoid bone, and connects it to the occipital, the temporal, inferior angle of the parietal, the frontal, and the æthmoid. The *æthmoidal* suture in like manner encircles the æthmoid bone and connects it to the frontal. The *frontal* or *coronal suture* proceeds from the upper extremity of the sphenoidal about an inch behind the external angle of the os frontis, ascends vertically inclining a little backwards, and then decends to the same point on the opposite side, it connects the frontal and parietal bones in the manner before explained. The *sagital suture* leads from the superior angle of the occipital bone directly forwards between the two parietal to the centre of the coronal suture, and is sometimes continued along the median line of the frontal bone down to the nose. The *lambdoid suture* extends on either side from the posterior extremity of the sagittal suture, downwards and forwards to the mastoid process of the temporal bone; a suture named the *additamentum of the lambdoid* continues down between this process and the occipital bone as far as the foramen lacerum posterius; the lambdoid suture is very rough and frequently containsossa triquetra of very irregular size, it connects the occipital and the two parietal bones; the additamentum is very little serrated, but presents uneven thick edges, it connects the occipital to the mastoid portion of the temporal bone, the mastoid hole is frequently in it, it nearly corresponds to the lateral sinus. The *squamous suture* on each side is continued from the extremity of the sphenoidal in an arched direction upwards and backwards, as far as the inferior angle of the parietal, it is then continued under the name of *additamentum of the squamous suture* directly backwards for about an inch; the structure of the squamous differs from that of the other sutures, the bones are not serrated but thin and scaly, and over lap each other, it unites the temporal to the parietal; the additamentum is serated and connects the inferior angle of the parietal to the upper part of the mastoid portion of the temporal bone, it corresponds to the course of the lateral sinus internally; a small os triquetrum is sometimes found at the anterior part of this suture, and seldom in any other situation.

OF THE SKULL IN GENERAL.

The *outer* surface of the skull presents 4 regions, the *superior* is smooth and even, has no remarkable appearance deserving more particular attention; the *lateral* regions are each divided into two, anterior or temporal, and the posterior or mastoid; the *inferior* region extends from the nasal notch to the occipital protuberance, and is bounded laterally by the zygomatic arches, and by a ridge which is continued from these processes round the skull with but little interruption; this region may be divided into three portions, anterior, middle, and posterior; the *anterior* extends from the superciliary ridges of the os frontis to the roots of the pterygoid processes of the os sphenoides; it presents the nasal spine and process of the os frontis, the æthmoid bone, the orbital plates of the os frontis, bounded by its angular processes before, and by the orbitar plates of the sphenoid behind; in this division are the supra-orbital, the anterior and posterior orbital holes, the openings of the frontal and æthmoid cells, the optic and lacerated holes of the orbits, the vidian canals and the formina rotunda. The *middle* division extends from the roots of the pterygoid to the styloid processes of the temporal bones, it presents the azygos process, the basilar process of the os occipitus, the anterior points of the petrous portions of the temporal bones; the spinous processes of the sphenoid, and the glenoid cavities of the temporal bones. The holes in this division are the oval, spinous, carotid, external, auditory, glenoidal, and the Eustachian tubes. The *posterior* division extends from the styloid processes of the temporal to the tuberosity of the occipital bone; it presents the foramen magnum, the two condyles the jugular ridge, the styloid processes of the temporal bones, surrounded by their vaginal processes, the mamillary processes, the digastric pits the inferior and superior transverse arches, the spine, protuberance and pits of the occipital bone; the foramina in this division are the stylo-mastoid, mastoid, magnum, lascera postica, anterior and posterior condyloid.

The skull is divided internally into the arch or vault and the base; on the vault is to be observed the sulcus for the longitudinal sinues, the frontal crest, the grooves for the middle arteries of the dura mater, the depressions for the convolutions of the brain, and for the granulations or glandulæ pacchionæ; the base of the skull is very uneven, and presents three portions on different planes, the anterior or frontal, the middle or spheno-temporal, and the posterior or occipital; the 1st is formed of the orbital plates of the frontal bone, the cribriform plate of the ethmoid, and the lesser wings of the sphenoid; the foramina in this division are the cæcum, olfactory, and optic. The 2nd division is bounded before by the transverse spinous processes of the sphenoid, on the sides by the squamous portions of the temporal, and behind by the superior angles of the petrous portions of the same bone, and by the posterior clinoid processes of the sphenoid; in the middle is the sella turcica, on each side of which, but below it, is a groove for the carotid artery, and for the cavernous sinus, and below this is a shallow groove for the superior maxillary nerve; further out on each side, are the cavities to lodge the middle lobes of the brain and on the anterior surface of the petrous bones are seen the juttings of the vertical semi-circular canals. The foramina in this division are, the foramina lacera orbitaria, superiora, rotunda, ovalia, carotica, spinosa, lacera basis cranii

anteriora, and innominata or hiatus Fallopii. The 3rd or occipital portion is bounded before by the basilar process, and by the posterior surface of the petrous bones, and behind by the occipital, it presents the basilar process, the foramen magnum, the perpendicular ridge of the occipital crossed by the transverse, by which this bone is divided into four fossæ, the superior angles of the petrous bones having a shallow groove for the superior petrosal sinuses, the transverse occipital ridge, with a deep one for the lateral sinuses, which last are continued over the inferior angles of the parietal bones, and thence descend inwards along the mastoid portions of the temporal bone, and then again groove the occipital bone, and pass forwards on it to the posterior foramina lacera; the perpendicular ridge is grooved above for the longitudinal sinus, which terminates sometimes in the left, and at other times in the right lateral sinus; the same ridge below the tentorium gives attachment to the falx minor, and is slightly grooved for the occipital sinuses. The foramina in this division are the foramina auditiva, aqueductus vestibulorum, foramina lacera postica, foramen magum, foramina condyloidea antica and postica.

THE BONES OF THE FACE.

These consist of six pair and two single bones; the six pair are the malar, superior maxillary, lachrymal, nasal, palatine, and inferior spongy; the two single bones are the vomer and the inferior maxillary.

The *malar* or *cheek bone* is placed at the outer, and under part of the orbit, and forms the prominence of the cheek; it is of an irregular square form, convex externally, and covered by the skin and orbicularis palpebrarum; it presents one or two small holes for vessels and nerves; its upper and outer edge is named *external orbitar process*, and joins the frontal bone; its inner end is cut off obliquely and serrated, is attached to and overlaps the maxillary bone, this is the *maxillary process;* the upper edge is round, smooth, and concave, forms part of the base of the orbit and ends internally in a long angle, named the *internal orbital process;* the lower is thick and uneven, and gives attachment to the masseter muscle, it ends posteriorly in the *zygomatic process*, which passes backwards, and terminates in a serrated edge which supports the zygomatic process of the temporal bone; behind this the malar bone is smooth, and forms part of the temporal fossa; from the posterior surface a thin plate extends into the orbit, and is named the *internal orbital process;* the posterior edge of this is notched to close the spheno maxillary fissure anteriorly. The malar bone is thick, strong, and cellular; it is well developed in the fœtus. It is joined to four bones, the frontal, sphenoid, temporal, and superior maxillary; the processes are five, the superior, inferior, and internal orbital, the malar, and zygomatic; the foramina are two or three proper and one common.

The *superior maxillary bone* is of a very irregular figure and attached to all the bones of the face; it forms part of the front of the face, a portion of the orbit, nose and palate; it may be divided into the body and processes. The *body* is concave anteriorly, to form the infra-orbital or canine fossa, in the upper part of which is the infra-orbital hole; it is bounded externally and above by a rough serrated surface, *the malar process*, which is smooth and hollowed out behind for the temporal muscle; springing from the inner and

upper part of the body, is the *nasal process* of a pyramidal form, perforated by one or two small holes for vessels, serrated above to join the os frontis, prominent below, slightly grooved anteriorly to receive the nasal bone and the alar cartilage, and deeply grooved behind to form part of the lachrymal fossa and duct; its internal surface forms part of the nasal fossa, and is connected to the ethmoid bone above, below this is a channel that leads to the middle meatus, and inferior to this is a crest for the spongy bone; between the nasal and malar processes is the *orbital plate*, of a triangular form, the base joined to the ethmoid, lachrymal and palate bones; this process looks downwards and forwards; its outer and posterior edge bounds the spheno-maxillary fissure; the infra-orbital canal, which runs along it in a direction forwards and inwards, lodges the vessels and nerves of that name; this canal divides anteriorly into two, the smaller is the *anterior dental*, which descends in the anterior wall of the antrum, where it terminates by communicating with the anterior alveoli, the other or the proper *infra-orbital canal* is wider, and ends in the infra-orbital hole; the edge of the bone above this hole is round to form part of the contour of the orbit, behind which the inferior oblique muscle of the eye arises; behind and below this plate is the *tuberosity*, this is more prominent in the young, as it contains the last molar tooth, after the protrusion of which it diminishes, near this are three or four small holes, the *posterior dental canals* which lead to the posterior alveoli; beneath the orbital plate, the body of the bone is excavated into a large cavity, the *antrum highmorianum*, of a somewhat triangular figure, the base towards the nose, the apex towards the malar process; this is the largest sinus connected with the nose, it is sometimes divided by septa as well as by the anterior dental canal into two or more cells; the infra-orbital canal runs along its roof, through the floor, one or two of the molar alveoli project and sometimes open, the canine fossa is in front of it, and the tuber bounds it behind, this cavity is lined by the membrane of the nose; in the skeleton the opening in its base is very large and irregular, but in the natural state it is contracted by the ethmoid bone above, by the palate bone behind, and by the inferior spongy bone below, also by the lining membrane of the nose; it opens by one or two small oblique openings into the middle meatus of the nose, anterior to which is the *infundibulum*, a deep groove leading downwards, backwards, and inwards, from the frontal sinus and the anterior æthmoid cells, and opening into the middle meatus; the body of this bone is bounded below by a strong horizontal plate the *palatine process*, the upper surface of which is smooth and concave, and forms the floor of the nose, the lower is rough, and forms the roof of the mouth; it is thick before, thin and serrated behind to join the palate bone, internally it is thick and rough, and joins the opposite bone, by a suture, in the anterior part of which is the anterior palatine canal, which opens inferiorly on the palate by the foramen incisivum, and superiorly by two distinct holes, one in each nostril; this internal edge is raised so as to form the *nasal spine* or *crest* to receive the vomer, anteriorly this projects so as to form the anterior *nasal spine*, to which the cartilaginous septum of the nose is attached; between this and the nasal process the bone is very concave and forms the anterior opening of the nares. The palate plate is bounded anteriorly and externally by the curved *alveolar edge* or *process;* this is very thick particularly behind, and is divided into several, generally eight conical

cavities for the teeth; the partitions between these are formed of dense cellular texture which is less compact posteriorly. The superior maxillary bone is connected to two bones of the cranium, the frontal and æthmoid, and to seven bones of the face, the nasal, lachrymal, malar, palate, inferior, spongy, vomer, and to its fellow of the opposite side, also to the teeth: it is sometimes connected to the pterygoid processes of the sphenoid. The processes are eight, the nasal, orbital, malar, tuberosity, alveolar palatine, nasal crest, and nasal spine; the foramina are three proper and four common; the proper are the infra-orbital the foramen antri, and foramen incisivum; the common are the spheno-maxillary fissure, the posterior palatine hole or canal, the anterior nares, and the nasal or lachrymal duct; this bone is well developed in the fœtus with the exception of the alveoli and sinus, which do not appear for a few years.

The *palate bone* is situated at the outer and back part of the nose, between the pterygoid processes and the superior maxillary bone, it is of a very irregular figure and may be divided into four parts: 1st, the horizontal or palate plate, 2nd, the nasal or perpendicular plate, at the lower and outer angle of which is 3rd, the pterygoid process; and 4th, at the upper extremity of the nasal is the orbital portion; the *palate process* or plate is nearly square, flat, and rough below, smooth above, and concave from side to side to form part of the floor of the nose, posteriorly it has a thin edge to which the velum palati is attached; its anterior border is serrated to join the palate plate of the maxillary bone, its inner edge rises into a *spine* or *crest* to support the vomer, and is continued posteriorly into the *posterior nasal spine;* its centre is thinner than its edges. The *nasal process* or vertical plate is broad and thin, rests partly on the maxillary bone, its inner or nasal surface forms part of the nasal fossa, and is marked by two depressions which assist in forming the lower and middle meatus of the nose, the ridge between these supports the lower spongy bone, externally it is uneven and grooved for the posterior palatine vessels and nerves; the anterior edge of this plate is thin and brittle, and prolonged for some way over the antrum, the posterior edge joins the pterygoid processes. The *tuberosity* or the *pterygoid process* arises from the lower and outer angle, is thick and wedge-shaped, it inclines backwards and outwards, and presents three fossæ, one at each side for each pterygoid plate, and one in the middle which assists in forming the pterygoid fossa; the innermost of these fossæ is the deepest: this process is perforated by one or two small holes which lead from the palatine canal: at the upper extremity of the nasal plate are the *orbital* and *sphenoidal processes*, separated from each other by a deep notch; the orbital is the larger and anterior of the two, it is triangular and bent a little outwards, it appears in the most remote part of the floor of the orbit, where it is joined to the maxillary bone by one edge, to the os planum by the second, while the third enters into the spheno maxillary fissure; the sphenoidal or posterior orbital process is smaller and is articulated to the body and spongy plate of the sphenoid bone; both these processes are cellular, the cells communicate with those of the æthmoid and sphenoid bones; the notch between these two processes forms the spheno palatine hole; the palate bone is joined to the maxillary, inferior spongy, vomer, sphenoid, and æthmoid, and to the opposite palate bone; it is composed of thin compact substance, and is well formed in the fœtus; its processes are seven, palate, nasal, pterygoid, orbital, sphenoidal posterior nasal spiræ and crest;

its foramina are one proper and two common. The proper is the posterior palatine hole or holes; the common are the posterior palatine or pterygo-maxillary canal and the spheno-palatine hole; the latter is above the nasal plate, below the body of the sphenoid, and between the orbital processes of the palate bone, it transmits the nasal nerve and artery from the spheno-maxillary fossa into the nose.

The *inferior spongy* or *turbinated bone*, placed on the lower part of the outer side of the nose, elongated from before backwards, it presents a wrinkled or a rugged surface, convex towards the nose, concave outwards, its lower edge is loose, spongy, and curled outwards; the upper edge is uneven, thin, and joined to the unguis, and to the maxillary and palate bones; it is connected to the unguis by a thin pyramidal process which completes the nasal duct; it is also in general united to the descending oblique process of the æthmoid, it is composed of very thin brittle substance marked with pores and little spines.

The *os unguis* or *lachrymal bone* is placed at the inner and fore-part of the orbit; below the os frontis, behind the nasal process of the superior maxillary and before the æthmoid bone, it is of an oblong square shape, and very thin, it covers the anterior ethmoidal cells; externally it is divided by a perpendicular ridge, which terminates below in a little hook-like process, into two unequal plates, the posterior or *orbital plate* is short and broad, the anterior *lachrymal plate* is concave, long and narrow, and forms part of the lachrymal or nasal fossa and duct. The os unguis is joined above to the internal angular and orbitar processes of the os frontis; behind to the os planum of the æthmoid, below to the orbitar plate of the maxillary, before to the nasal process of the same, and before and below to the inferior spongy bone; its structure is very thin but compact.

The *nasal bones* are situated beneath the nasal process of the frontal and between the nasal processes of the superior maxillary bones, they are small, narrow, and thick above, thin and expanded below; they form the bridge of the nose; the external surface of each is slightly concave from above downwards, convex from side to side and perforated with one or two small holes; the internal surface is concave and grooved for the nasal nerves; the superior margin is thick and deeply denticulated to join the nasal process and spine of the frontal and the nasal plate of the æthmoid bones; its external edge is grooved and received into the nasal process of the superior maxillary, its inner edge is flat to join with its fellow, and its lower edge is thin and irregular, and joins the alar cartilages of the nose, and is notched for the passage of the nasal branches of the ophthalmic nerve.

The *vomer;* this azygos bone resembles a ploughshare; it stands in the median line, although it often bends a little to one side, is thin and flat and covered by the pituitary membrane, it presents four edges; the upper or sphenoidal is hollowed to receive the azygos process; the anterior is slightly grooved to receive the æthmoidal lamina and the nasal cartilage; the posterior or pharyngeal is round and smooth and unattached; the inferior or palatal edge is the longest, and is received between the laminæ of the nasal crest of the maxillary and palate bones: it is attached to the maxillary, palate, æthmoid, and sphenoid bones, also to the turbinated bones of the latter; its structure is compact, but thin and transparent.

The *inferior maxillary bone*, or the lower jaw, is the largest of the facial bones, it is of a semicircular figure situated at the lower part of the face and extending along its sides and back part to the base of the skull; it is divided into the body or chin, the sides, the rami, and the processes; the *body* is the anterior prominent portion with a verticle ridge in the centre, the *symphisis*, or the line of union of the two symmetrical pieces of which this bone in infancy consisted; inferiorly the body projects into the mental process or chin, above this, on each side is a depression for the muscles of the lower lip, external to which and looking backwards is the oval oblique opening of the dental canal, called the *mental hole*, through which a vessel and nerve of the same name pass; posteriorly the body of the bone is concave, and lined above by the mucous membrane, in the middle it presents in the line of the symphisis, a chain of eminences, to the superior of which the frænum linguæ adheres, to the middle the genio-hyo-glossi, and to the inferior the genio-hyoidæi muscles; above and on each side of these are depressions for the sublingual glands, and at the lower border are two depressions for the digastric muscles. The *sides* of the maxilla have a direction backwards and outwards, on their outer surface is an oblique line which passes backwards and upwards to the anterior edge of the coronoid process, it gives attachment before to the platisma and depressor anguli oris, and behind to the buccinator muscles; internally also is an oblique line, parallel to, but more prominent than the external, to this is attached the mylo-hyoid muscle anteriorly, and the superior constrictor of the pharynx posteriorly; beneath this line is a slight groove which contains the mylo-hyoid nerve, and below this an oblong depression for the submaxillary gland; the lower edge or base of the jaw is rounded, thick before, thin behind, and grooved opposite the second molar tooth for the facial artery; the upper or alveolar edge is broad posteriorly and bent a little inwards; it has usually 16 alveoli, which, as in the upper jaw, vary in form according to that of the teeth. The *angle* of the jaw is more or less obtuse, and often bent a little outwards; the masseter adheres to it externally, the internal pterygoid internally, and the stylo-maxillary ligament to the border of it. The *ramus* ascends a little backwards, is thick and round posteriorly and is enveloped by the parotid gland, externally it is covered by the masseter, internally it presents a deep groove which leads to a large hole, the *inferior dental* or *maxillary;* this is situated near the centre of the ramus, and is protected internally by a prominent spine into which the internal lateral ligament is inserted, a slight groove leads from this hole to the mylo-hyoid muscle; the dental hole leads into a canal which traverses the side of the bone beneath the alveoli, with each of which it communicates; it contains the dental nerve and vessels; below the incisors this canal turns back a little and ends at the mental hole; this canal is nearer the inner surface of the jaw behind, and the outer surface before; the ramus ends above in a notch and two processes, the anterior or coronoid, the posterior or condyloid; the notch is traversed by the masseter nerve and vessels. The *coronoid process* is triangular, the apex is inclined a little outwards, it is embraced by the insertion of the temporal muscle. The *condyle* is an oblong convex process supported by a neck which is most depressed anteriorly, for the insertion of the external pterygoid muscle; the condyle is curved forwards and most convex in that direction; it is directed obliquely backwards and inwards, so that its internal

extremity is posterior, it is also higher than the external; its posterior surface is nearly straight and almost free from cartilage. By these processes the lower maxilla is articulated with the temporal bones; on the external edge of each is a tubercle for the insertion of the external lateral ligament. The lower jaw in the young subject always consists of two symmetrical pieces.

The *teeth* are small, hard bones, 32 in number, 16 in each jaw; their form is generally conical the apex in the alveoli ; in each tooth we distinguish the crown, neck, and root; the *crown* is external to the alveolus, it has no periosteum, but is covered by a firm white vitreous substance, named enamel: the *neck* is surrounded by the gum, and the *root* is firmly held in the alveolus by a mode of connection called gomphosis. The teeth are divided into three classes, the incisores, the canini, and the molares: the *incisores* are four in each jaw, the crown of these is sharp, and wedge-shaped, convex before and thickly covered with enamel; those in the upper are stronger than those in the lower jaw; the former are broader, their edge is like a chisel, cut off posteriorly, the latter are more vertical, their anterior surface is bevelled off, but they are not so sharp as those in the upper jaw, their roots are larger; the the *canine teeth* or *cuspidati* are 2 in each jaw, the crown is conical, a little blunt, convex before, their root is single but very long; the *grinders* or *molares* are 10 in each jaw, the crown of these are broad and irregular, the roots are more or less divided, the upper grinders are stronger than the lower, the axis of the former are directed outwards, in the latter it is vertical, the two first molar are called *bicuspidati*, and are smaller than the canine; they have only two tubercles on the crown and the fang is single but sometimes it is double, the posterior grinders are the true molar or *multicuspidati*, these are large; the crown has four or five tubercles, the root has three or four divisions, each is perforated by a small hole. The teeth are composed of a very compact bone or ivory, less brittle than the enamel; the latter only covers the crown as far as the neck; the ivory has no cells in it, its fracture is silky in addition to the component parts of bone it also contains some fluate of lime; it possesses the power of resisting the action of the air a long time; the enamel is very white and so hard as to strike fire with steel; it is composed of fibres which are perpendicular to the surface of the crown, it is thicker where the teeth are exposed to much friction, it does not contain any vessels or nerves and is not regenerated when once destroyed; each root is perforated with a small hole which leads into the cavity in the crown; this cavity contains a pulp which is very vascular and nervous.

The bones of the face are connected by sutures in the same manner as those of the cranium, it is unnecessary to describe these individually, as they are all named from the particular bones they unite. The facial bones, in addition to forming the general outline of the face, also bound several regions, namely, the nose, orbits, palate, temporal, zygomatic and spheno-maxillary fossæ. The bones entering into the nose have been already mentioned in the description of the organs of sense.

The *orbits* are of a pyramidal figure, the base looking outwards and forwards, the apex backwards and inwards: 7 bones enter into the parieties of each, the frontal, sphenoid, lachrymal, maxillary, palate, and malar; the upper wall or the roof of each orbit is formed by the frontal and the lesser wing of the sphenoid, it is concave, and presents the optic hole posteriorly and the depressions

for the lachrymal gland and for the trochlea anteriorly; the floor is nearly plane and looks outwards and downwards, it is formed of the malar, maxillary, and palate bones, the infraorbital canal extends along it: the external wall is formed by the sphenoid and malar bones, and the internal, which is smooth and plane, is formed by the lachrymal, æthmoid, and sphenoid bones. The bones which form the base of the orbit are the frontal, malar, and maxillary, the foramina in the base of the orbit are 4, viz. the supraorbital, the infraorbital, the malar and the nasal duct; within the orbit are 5, viz. the optic, which is in the upper, inner and posterior part, the foramen lacerum superius, which leads from the apex upwards and outwards, the two internal orbital holes which are found in or close to the suture along the internal wall and the spheno-maxillary fissure, or the inferior lacerated hole which leads from the back of the orbit forwards and outwards along the floor; this slit-like opening is bounded by the sphenoid, palate, maxillary, and malar bones. The axes of the two orbits are oblique lines, which, if produced posteriorly, would decussate about the sella turcica, while anteriorly they would diverge.

The *palatine region* is composed of the palate plates of the superior maxillary and of the palate bones, and is bounded by the alveolar arch, by the pterygoid processes of the palate bones and by the hamular processes of the sphenoid; to its posterior edge the soft palate and uvula are attached; anteriorly it presents the foramen incisivum or the anterior palatine canal, and posteriorly the two posterior palatine canals.

The *temporal fossa* is placed on the side of the cranium and face; it is bounded internally by the frontal, sphenoid, parietal and temporal bones; its extent superiorly is defined by the semilunar ridge on the side of the cranium, anteriorly by the malar bone, posteriorly by the pulley-like root of the zygomatic process, and inferiorly and externally by the zygomatic arch which is formed by the processes of that name from the temporal and malar bones; this arch is concave above and internally, convex below and externally.

The *zygomatic fossa* is continuous with the lower part of the last described region, from which it is distinguished by a transverse ridge or crest near the root of the great wing of the sphenoid bone, from this it extends to the tuberosity of the maxillary bone, and is bounded externally by the ramus of the lower jaw.

The *pterygo-maxillary fossa* is a very narrow space, it is enclosed between the pterygoid processes behind and the tuberosity of the maxillary bone before, it is bounded internally by the nasal lamella of the palate bone, which separates it from the nose; it is immediately below and behind the orbit, with which it communicates by the spheno maxillary fissure, it also communicates with the palate by the posterior palatine canals, and with the nose by the spheno palatine hole, it also leads into the temporal and zygomatic fossæ.

The *extremities* are two superior and two inferior.

The *inferior extremity* is divided into three parts, the thigh, leg, and foot; the thigh contains but one bone, the femur.

The *femur* is the longest bone in the system, it consists of the body or shaft and two extremities; the body is slightly twisted, thick above, very broad below, contracted and nearly cylindrical in the centre, arched and smooth before and concave behind, with a sharp rough ridge down the centre, named

the *linea, aspera* this extends along the middle third of the bone, parallel to its axis and divides above and below into two ridges, these pass superiorly one to each trochanter, that to the inner being the shorter; and inferiorly one to either condyle; these inferior divisions separate further and enclose a flat triangular space, the popliteal; this line is very prominent about the centre and presents two lips and an interstice, for the attachment of different muscles; the anterior convex surface of the femur is broader towards either end than in the centre, it is a little concave superiorly, the sides are slightly flattened, and the external is somewhat broader than the internal, particularly above; above the middle of the linea aspera one or two holes may be seen to enter obliquely upwards, these transmit the nutritious or the medullary vessels of the bone; to the linea aspera in the middle of the thigh, the vastus externus, the adductor tendons, and the vastus internus are attached, to the superior external branch which leads to the great trochanter and is very long, the adductor magnus, gluteus maximus, and vastus externus are attached, the internal branch is short and not very distinct, it leads to the lesser trochanter and gives attachment to the adductor brevis, pectinæus, vastus internus, and some fibres of the iliacus internus; to the lower and external branch of the linea aspera, the vastus externus and short head of the biceps are attached, and to the lower and internal, the vastus internus and adductor magnus adhere; these lines continue as low as the condyles, the internal is smooth and nearly obliterated near its middle for the passage of the crural artery. The upper or pelvic extremity of the femur presents three eminences, the head for articulation with the cotyloid cavity and the trochanters for the insertion of muscles. The *head* is of a globular figure, and forms a considerable segment of a sphere, it is directed upwards, forwards and inwards; a little below its centre there is a rough depression for the insertion of the round or articular ligament; with the exception of this depression the head is covered throughout with cartilage, it is supported by an elongated process, the neck which forms an angle, more or less obtuse, with the shaft of the bone, the direction of this process is upwards, inwards, and a little forwards, it is flattened before and behind, thicker at the shaft than at the head, its lower edge is longer but smaller than the upper; a rough irregular line separates the head from the neck, beyond which the articular cartilage does not extend, and at its juncture to the shaft two rough lines extend, inwards and downwards, from the great to the lesser trochanter, one on the fore, the other on the back part of the bone, into these the capsular ligament is inserted. The *great trochanter* is continuous with the external side of the shaft, and nearly in a line with its axis, it is on a little lower level than the head, it is thick, rough, and square, externally it is broad and convex, the tendon of the gluteus maximus moves over this surface and an intervening bursa, a prominent ridge bounds it below, to this some fibres of the vastus externus are attached, internally it presents a pit or digital cavity which receives the tendons of the external rotators of the limb, namely, the pyriform, gemelli and obturators; the summit of the trochanter is thick and rough, the glutæus medius is inserted into it, the anterior edge is broad, and gives attachment to the glutæus minimus, into the posterior, which is round and thick, the quadratus femoris is inserted. The *lesser trochanter* is a conical projection at the posterior and inner side of the shaft, and considerably below the great trochanter; it looks

backwards and inwards, the tendons of the psoas and iliac muscles are inserted into it behind its apex, a bursa is connected to it anteriorly. The inferior or *tibial end* of the femur is very large and broad, and divided into two eminences or *condyles* which are separated posteriorly by a deep notch; the *condyles* articulate with the tibia; the *external* is larger, and projects more forward than the internal, its articulating surface is also broader and ascends higher, externally it is rough and presents a tuberosity which gives attachment to the external lateral ligament of the knee joint; this is less prominent than the internal tubercle, beneath this tubercle is a groove which receives the tendon of the poplitæus muscle in the flexed position of the joint; internally this condyle presents a rough surface, towards the posterior part of which the anterior crucial ligament is inserted, it is very convex behind, flat before and broad below. The *internal condyle* is narrower, less prominent before but prolonged more behind; it is also longer than the external, and therefore descends lower when the femur is vertical, but both are nearly on a level when the bone is in its ordinary oblique direction; on its inner side is the tubercles for the attachment of the internal lateral ligament of the knee and for the adductor tendon; to its outer side, which is rough, the anterior crucial ligament adheres; both condyles are more convex behind than before, they are separated posteriorly by a deep uneven notch, which lodges the crucial ligaments and is deprived of articular cartilage; anteriorly they are continued into each other, and unite in a pulley-like surface which is convex from above downwards, and concave from side to side, higher externally than internally; this *trochlea* is chiefly formed on the external condyle, it supports the patella: the femur is articulated superiorly with the ilium, inferiorly with the tibia and anteriorly with the patella; like all long bones it is composed of compact tissue in the centre and cellular at the extremities, the compact has a fibrous appearance, the whole shaft is traversed by a distinct medullary canal, which is crossed by numerous bony laminæ; the femur is developed by 5 points of ossification, one for the shaft, one for the tibial end, one for the head, and one in each trochanter.

The bones of the *leg* are the patella, tibia and fibula.

The *patella* or *rotula* or knee cap is a small bone in front of the knee joint, of a triangular figure, the base above, the apex below, its anterior surface is convex and covered by skin, a bursa and some tendinous fibres, it is marked by several longitudinal lines, and presents a very fibrous appearance; the posterior surface is covered with cartilage and divided by a prominent vertical line into two lateral portions, of these the external is larger and deeper than the internal; beneath these is a small triangular depressed surface into which the ligament of this bone is inserted; the upper edge is round and cut off obliquely backwards and downwards, to it the extensor tendons are attached; the patella is of a cellular structure covered by a compact lamina which is very dense, and traversed by longitudinal striæ; it is developed from a single point of ossification and remains for a long time cartilaginous; it is articulated with the condyles of the femur, and connected to the tibia by a powerful ligament; it protects the fore part of the knee, and serves as a medium of connection between the extensor tendon and the leg.

The *tibia*, next to the femur, is the longest bone in the skeleton, it occupies the anterior and inner part of the leg, its upper extremity is thick and expanded from side to side, its circumference is somewhat circular or oval, convex on the

front and sides, but slightly grooved behind; on either side is a protuberance, that on the internal is the more prominent for the insertion of the internal lateral ligament and the tendon of the semi-membranosus muscle; a little behind the external tuberosity is a small rounded surface looking downwards, covered with cartilage for articulation with the head of the fibula, on the anterior part of the head is a convex triangular surface looking forwards and downwards, pierced with many vascular holes, and terminating in a tubercle, to the upper part of which a bursa adheres and into the lower the ligamentum patellæ is inserted. The upper or femoral surface of the tibia presents two concave or articulating surfaces or *condyles* covered with cartilage, for articulating with the femur, the *internal* is oval and the deeper of the two, it is also larger from before backwards; the *external* is nearly circular, very superficial, and looks obliquely downwards and outwards; these are separated by a *spine*, which is of a pyramidal form, inclines upwards and inwards and is surmounted by two tubercles; it is nearer the back than the forepart of the bone; a large flat depressed surface lies anterior to it and a smaller depression behind it; the semilunar cartilages and the crucial ligaments are inserted into these; the *body* of the tibia is triangular, its size diminishes from its head for about two-thirds down, it then increases somewhat towards its lower end; its inner side is convex above and a little concave below, it is directed obliquely forwards, is covered superiorly by the tendinous expansions of the sartorius, gracilis, and semi-tendinosus, but the remainder of it is subcutaneous; the external side appears a little twisted, it is concave above to support the tibialis anticus muscle, but convex below to support the tendon of that muscle as also those of the extensors; its posterior surface, which is also broader above than below, is slightly convex; it presents superiorly a prominent line passing obliquely downwards and outwards for the insertion of the poplitæus and the origin of the solæus and the deep flexors; near this line is the opening of the large canal that leads the vessels to the medullary membrane, it slants obliquely downwards and forwards. The tibia presents three edges, one is anterior and very prominent about the middle, but less so above and rounded below, this line is subcutaneous, it is twisted like the tibia itself and is commonly called the crest or the shin, the inner edge is thick and round and more distinct below than above, the outer edge is thin and gives attachment to the interosseous ligament; it is less distinct and bifurcated below. The lower or *tarsal end* of the tibia is somewhat square, presents an anterior convex edge covered by the extensor tendons, a posterior nearly smooth edge traversed by a groove for the tendon of the flexor pollicis longus, externally is a concave triangular surface, rough above for ligaments, and smooth and cartilaginous below to receive the lower end of the fibula; internally the tibia ends in a thick flattened perpendicular process, the *internal maleolis* or ankle; it is convex and subcutaneous, it lies anterior to the superior internal tuberosity on account of the twisting of the bone; the outer side of this process is smooth and cartilaginous, and joined at right angles to the cavity at the lower end of the bone; it is articulated to the side of the astragalus, its anterior edge is convex and gives attachment to ligaments, its posterior edge is grooved superficially for the tendons of the tibialis posticus and flexor communis, the extremity of this process is broad and descends lower before than behind, it gives origin to the internal lateral ligament of the ankle; the lower surface of the tibia is quadrilateral, concave from before backwards, and

somewhat convex from side to side, being traversed from before backwards by a very superficial ridge or prominence, this surface is broader externally, it is bounded internally by the internal malleolus, and externally by the fibula; the tibia is articulated to the femur, the fibula and astragalus; its ossification commences in three points, one for the shaft, and one for each extremity, the tubercle at the upper end of the crest, and the malleolus are sometimes found as epiphyses.

The *fibula* is very slender and nearly as long as the tibia; it is placed at the side of the leg, nearly vertical, its lower end inclined a little forwards; the superior or *femoral end* is small and circular, and presents a slight cavity forwards, upwards and inwards, to articulate with the tuberosity on the external condyle of the tibia, behind this is a slight pyramidal projection, its whole circumference is rough for the insertion of ligaments which attach it to the tibia, also for the external lateral ligament of the knee joint, and for the tendon of the biceps; below this the bone is round and slender like a *neck;* the *body* then becomes triangular, is twisted a little and curved outwards, its inner surface looks a little backwards above but is twisted forwards below; this is divided into two portions by the internal edge into which the interosseous ligament is inserted, the anterior portion gives attachment to the extensors, and the posterior is grooved for the tibialis posticus, its external surface is covered by the peronæi muscles, the posterior surface gives attachment to the solæus above and to the flexor pollicis below; in this surface we perceive the orifice of the vascular canal leading downwards; the internal edge gives attachment to muscles above and to the interosseous ligament below, the external edge is turned backwards and gives attachment to the solæus, flexor pollicis, and peronæi muscles; and the anterior edge to the extensor digitorum and to the peronæi; inferiorly this edge turns outwards, and bifurcates, enclosing a triangular surface, which is subcutaneous; the *lower* or *tarsal end* is larger than the head, it is elongated into a long oval process, the *external malleolus* or *ankle,* this is larger, more prominent and posterior to the inner ankle, it is convex and subcutaneous externally, internally it is smooth and triangular, a little concave from behind forwards and convex in the perpendicular direction, it articulates with the astragalus, above this is a triangular rough surface to articulate with the tibia, anteriorly this process is rough but thin for the origin of ligaments, its posterior edge is broader and grooved for the peronæal tendons, internal to which is a depression for the origin of the posterior lateral, or the transverse ligament of the ankle joint; from the point of this process the external lateral ligament arises; the fibula is articulated at both ends to the tibia and below to the astragalus.

The *foot* is divided into the tarsus, metatarsus, and toes. The bones of the *tarsus* are 7, astragalus, calcaneum, navicular, cuboid, and 3 cuneiform.

The *astragalus* is next to the calcaneum in point of size, it is of an irregular twisted shape, larger above and to the outside than internally or posteriorly; it is situated at the upper and middle part of the tarsus, where it is wedged between the two malleoli, its superior surface presents in its two posterior thirds a large pulley-like articular surface, which is convex from behind forwards, and concave transversely, it is inclined a little backwards, is broader before than behind, and more prominent externally than internally; anterior to this is a rough depression, on the neck of the bone, for the insertion of

ligaments; inferiorly, it presents two articular surfaces for the os calcis, one is posterior and external, broad and concave, the other is anterior and internal and convex; these surfaces are separated by a deep groove, which is narrow behind, broad before, and directed forwards and outwards; strong ligaments pass from this groove to the os calcis; the posterior surface of the astragulas is narrow and slightly grooved in an oblique direction, downwards and inwards for the tendon of the flexor pollicis; it presents externally a pointed eminence to which the external lateral ligament of the ankle joint is attached; the anterior extremity is a smooth round head supported by a sort of neck, it is directed forwards, inwards and downwards, and is articulated with the navicular bone; the external side presents a triangular, smooth surface, concave from above downwards, and a little convex from before backwards, it is articulated with the fibula; the inner side is rough for ligaments, except a cartilaginous surface near the upper part, which is smaller than that on the outer side, and broader before than behind, this is articulated with the internal malleolus.

The *calcaneum* or *os calcis* is the largest bone in the tarsus, at the lower and posterior part of which it is placed, it is elongated posteriorly into a process called the heel, its upper surface presents two articulating surfaces to support the astragalus; the posterior is convex, broad, and directed forwards and outwards, the anterior is internal, narrow, and concave; these are separated by a deep rough transverse groove into which strong ligaments are inserted; internal to this the bone is uneven, and projects into a sort of process, into which the internal lateral ligament of the ankle joint is inserted; the inferior surface is smaller than the superior and is nearly flat, it presents small tubercles for the attachment of muscles and ligaments: the posterior extremity is slightly convex, smooth above and covered by a bursa, and rough below for the insertion of the tendo achillis; the anterior extremity is smaller, and presents an articular surface for the cuboid bone, which is concave from above downwards and convex from side to side; externally it is rather flat, being marked with two shallow grooves, for the peronæal tendons, a spine separates these, into this the external lateral ligament of the ankle joint is inserted, internally it is broad and hollowed out into an arch, under which the flexor tendons, the tibialis posticus and the plantar vessels and nerves pass, the tendon of the flexor pollicis runs in a distinct groove; the os calcis is attached above to the astragalus and before to the cuboid.

The *navicular* or *scaphoid bone* is situated about the middle of the tarsus and at its upper and internal part; of an oval form, its posterior surface is smooth and concave, to form a sort of superficial or glenoid cavity for the head of the astragulas, the latter, however, is much larger and projects inferiorly, in which direction it is supported by the strong calceo-scaphoid ligament, and by the tendon of the tibialis posticus, which here generally contains a sesamoid bone; the anterior surface is convex, and divided by two vertical ridges into three surfaces for the three cuneiform bones; the circumference is irregular for the attachment of ligaments, internally it is rather smooth, but inferiorly it presents a tubercle into which the tibialis posticus is inserted; on its external side there is in general a small flat articular surface for the cuboid bone; the scaphoid is connected to the astragalus, to the three cuneiform and to the cuboid bones

The *cuboid bone* is situated at the outer and anterior part of the tarsus external to the navicular, and anterior to the calcaneum; although of a cubical form, it is yet thicker and longer internally than externally, its upper surface is flat and rough for the attachment of ligaments and muscles, the lower surface is irregular, rough and tubercular behind for the calceo-cuboid ligament, and groved before for the tendon of the peronæus longus, its posterior surface is smooth, concave transversely, and convex from above downwards; it articulates with the calcaneum, anteriorly it presents two articular surfaces, the internal is square and supports the fourth metatarsal bone, the external is triangular and supports the fifth; the external side is narrow, the internal is rough posteriorly but presents anteriorly two articulating surfaces, the posterior for the scaphoid, and the anterior for the external cuneiform bone; the cuboid is articulated with the calcaneum, the scaphoid, the external cuneiform, and the two external metatarsal bones.

The *cuneiform bones;* these three wedge-shaped bones are situated at the anterior part of the tarsus, between the scaphoid and the three internal metatarsal bones; the first or the internal is the largest of the three, its base is below and its long axis is from above downwards, it is articulated posteriorly to the scaphoid bone, anteriorly to the first, and externally to the second metatarsal bone, and to the middle cuneiform, inferiorly it presents a tubercle for the insertion of the tibialis anticus, and for a portion of the tendon of the tibialis posticus; the middle cuneiform is the smallest, and is wedged in between the two others; it is also articulated behind to the scaphoid and before to the second metatarsal bone; the third or external cuneiform bone is situated between the last and the cuboid bone, it is articulated anteriorly with the third metatarsal bone; posteriorly with the scaphoid, internally with the middle cuneiform and with the second metatarsal bone, and externally with the cuboid, and with the fourth metatarsal bone. All the bones of the tarsus are composed of a soft spongy vascular tissue covered by a compact, but thin lamina; they are each developed from one point of ossification, except the calcaneum and the astragalus, which commence each in two points.

The *metatarsal bones* are five in number, the first or internal is the shortest and thickest, convex above, concave and sharp below, its posterior end is oval, concave, and rests on the internal cuneiform bone, the anterior end round and smooth, supports the first or great toe, this extremity is grooved below, and lodges the sesamoid bones, the peronæus longus is also inserted into it; the second is the longest of the metatarsal bones, its tarsal end is wedged in between the three cuneiform bones, and is articulated to each of them; the outer side of its base is also joined to the third metatarsal bone, its anterior extremity or head is round, and supports the second toe, it is marked internally and externally by the depressions for the lateral ligaments, a groove separates the head from the body of the bone; the third metatarsal bone is a little shorter than the second, but of the same form; its base rests on the third cuneiform bone; the fourth metatarsal bone is a little shorter, it rests on the cuboid bone, and the inner side of its base also rests against the third cuneiform bone; the fifth is the shortest except the first, it rests on the cuboid bone; the heads of all the metatarsal bones are round, the bases flat to articulate with the tarsus, the sides of their bases are also flat to join one another; all these bones possess a similar structure, and resemble the class of long bones.

The *toes* are five in number, the first or the great toe has only two phalanges, all the others have three; there are therefore fourteen phalanges in all; the *first phalanges* are longest, they are convex above, concave below; their posterior end is larger, and presents a round concavity, for the head of the metatarsal bone, the anterior end is convex from above downwards, and concave from side to side, so as to form a ginglymoid joint with the second phalanx. The *second phalanges* are very short, the great toe has none, the posterior end of each is concave from above downwards but convex transversely, being divided by a vertical ridge; the anterior extremity is similar to that of the first phalanx, its condyles are less prominent. The *third phalanges* are all very small except that of the great toe, they are of a pyramidal form, and support the nails, their posterior extremity being very large and similar to that of the middle phalanges, their anterior end is tubercular and attached to the cellulo-vascular texture at the extremity of each; at the base of the first phalanx of the great toe there are in general two *sesamoïd bones* into which the small muscles of this toe are inserted, frequently also there is another at the base of the second phalanx, sometimes one is found at the first joint of the second toe, and another at that of the fifth.

THE SUPERIOR EXTREMITIES.

Each *superior* or *thoracic extremity* consists of the shoulder and fore-arm, wrist, and hand; the shoulder is composed of the clavicle and scapula, the arm of the humerus, the fore-arm of the radius and ulna, the wrist of the eight small carpal bones, the hand of the five metacarpal and fourteen phalangal bones.

The *clavicle* extends from the summit of the sternum obliquely across the first rib, upwards, backwards, and outwards to the acromion process of the scapula, it is curved somewhat like an italic *S*, particularly in the male, in the female it is straighter and longer, it consists, like all long bones, of two extremities and a body or shaft; the *internal* or *sternal end* is thick, it presents a triangular articulating surface, inclined forwards and downwards, convex from above downwards, concave from before backwards, large above and before, small and pointed below and behind, the circumference is rough for the attachments of ligaments; the *body* is nearly cylindrical towards the sternal, but flat and expanded towards the acromial end, smooth above and mostly subcutaneous, inferiorly it is rough, and presents about an inch from the sternal end, a ridge or process for the rhomboid ligament, external to this is a groove for the subclavian muscle, in which is a foramen for the nutritious vessels, and near the scapular end is a rough ridge leading backwards and outwards for the attachment of the coraco-clavicular ligaments; its anterior edge is convex in the inner half, and gives attachment to the great pectoral muscle; the outer half is concave, the deltoid is attached to it; the posterior is smooth and concave in the inner half towards the great vessels, and rough and convex externally for the attachment of the trapezius muscle; the *acromial end* of the clavicle passes over the coracoid process upwards and backwards, is flat and broad, rough above and below, and perforated by vessels; it presents at its termination a small articulating surface for the acromion scapulæ; this surface is oval from before backwards, and cut obliquely from above and from without downwards and

inwards, its aspect is outwards, forwards and downwards, its circumference is rough for the attachment of ligaments; the clavicle serves to support the scapula and to prevent it from falling too much forwards or inwards, it thereby allows it a greater freedom of motion, it also serves as a fixed point for certain muscles, and it protects the vessels and nerves of the upper extremity; it is very perfect in the fœtus, and is developed from a single point of ossification; it has no perfect epiphysis, although in the young subject there is an osseous crust at each extremity, which is at first separable from the rest of the bone.

The *scapula* is situated at the upper, lateral, and posterior part of the chest, and extends from the second to the seventh rib, it is irregularly flat and triangular, it presents an internal and an external surface, three edges and three angles; the internal or anterior surface or *subscapular fossa* looks towards the ribs, is slightly concave and divided by three or four prominent lines which run obliquely from above downwards, and from without inwards into several broad grooves, which are filled by the fasciculi of the subscapular muscle, the apoueurosis of which is attached to those ridges; above and below these is a smooth flat surface to which the serratus magnus is attached; the external or posterior surface or the dorsum is divided transversely into two unequal parts by a ridge or *spine* which commences at the posterior border of the scapula, from a smooth polished flat triangular surface, it proceeds forwards and becomes more elevated, flattened above and below, and bounded by long irregular undulated margin, which is rough above for the attachment of the trapezius, and below for that of the deltoid muscle; a vascular hole is observed on its upper and under surface; this spine is a little contracted anteriorly and externally, and terminates in an eminence named the *acromion process;* this surmounts the shoulder joint, about an inch above it is flattened in a direction contrary to that of the spine, its external surface looks a little upwards and backwards, is convex, rather rough and covered by the integuments, its inferior or internal surface is smooth and concave, its upper edge is directed backwards, gives attachment to the trapezius and presents near its termination a small oval articulating surface for the clavicle; the lower edge gives attachment to the deltoid, its apex its rounded for the insertion of the triangular or coraco-acromial ligament; above this spine is the *supra-spinata fossa,* which is wider behind than before, this is filled by the supra-spinous muscle the *fossa infra-spinata* is larger, is convex above and concave and grooved inferiorly; between this and the inferior costa is a raised surface extending from the inferior angle to the glenoid cavity; this surface is divided into two by an oblique line, the posterior portion is flat and somewhat square, and gives attachment to the teres major muscle, the anterior to the teres minor; into the ridge between these is inserted an aponeurosis common to these two muscles; the *superior* or *cervical* costa or border of the scapula is the shortest and thinnest; at its fore-part is a notch which is converted into a hole by ligament and sometimes by bone; it is traversed by the supra-scapular nerve, and sometimes by the vessels of that name, to this costa, the supra-spinatus, subscapular, and omohoid muscles are attached; from the anterior part of this border in front of the notch arises the *coracoid process,* which is long and narrow, and directed at first upwards and forwards and then downwards, convex and rough above for the attachment of the coracoid and trapezoid ligaments, smooth and

concave below, it overhangs the inner and upper part of the glenoid cavity, the pectoralis minor is inserted into it anteriorly, the biceps and coraco-brachialis into its summit, and the triangular ligament into its external border. The *base* of the scapular or the posterior or vertebral edge is nearer the spine above than below; the spinati muscles adhere to its outer lip, the subscapular to its inner, and the rhomboid to its middle; about one fourth from its upper extremity is a blunt projection formed by the smooth triangular root of the spine; at the union of the base and upper costa is the *superior posterior angle*, which is embraced by the levator anguli muscle. The *anterior* or inferior or external or *axillary costa* is very thick and inclines downwards and forwards, at its junction with the base it forms the *inferior angle* on which is a long flat surface which gives origin to the teres major, and to a few fibres of the lattisimus dorsi muscle; to the upper part of it the long head of the triceps is attached; at the convergence of this and the superior costa, the glenoid cavity and the neck of the scapula are situated. The *neck* is that contracted portion, which gives attachment to the capsular ligament, it is most distinct externally and inferiorly. The *glenoid cavity* is superficial, oval, broader below, covered with cartilage, and in the recent subject deepened by the fibrous glenoid ligament, which is chiefly derived from the long tendon of the biceps, which is attached to the upper extremity of the cavity; it is inclined a little downwards, outwards, and forwards,; its aspects however varies, as the scapula is made to turn in all the rotatory motions of the arm. The scapula is composed of two compact laminæ, and an intervening cellular tissue, the latter prevails in the processes, the neck and the inferior angle; in the middle of the fossæ there is but little of it, and the compact substance is there thin and transparent. The scapula is developed by several points of ossification, one in the centre of the body, one for each of the processes, one for the inferior angle, and one for the posterior or vertebral edge.

The *os humeri* is attached to the scapula above and to the radius and ulna below; it is the longest and largest bone in the upper extremity, it presents two extremities and a body or shaft; the *upper* or *scapular extremity* is the larger, and consists of the head, neck, and 2 tubercles. The *head* is semi-spherical, inclined upwards, inwards, and backwards, smooth and covered with cartilage for articulating with the glenoid cavity of the scapula; the *neck* is the slightly contracted line around the head; it is rough for the attachment of the capsular ligament, and a little longer below and before than above or behind; the axis of the neck and head forms an obtuse angle with that of the shaft; the *tuberosities* are two, the greater and lesser; the *great* or *external* is also posterior, it is round, and presents three depressions; to the anterior of these the supra-spinous muscle is attached, to the middle the infra-spinous, and to the posterior the teres minor; the *lesser tuberosity* is also anterior; it is more prominent, and gives insertion to the subscapsular tendon; between these tubercles is the deep groove for the long tendon of the biceps, into the anterior edge of which the tendon of the great pectoral is inserted, and into its posterior those of the teres major and latissimus dorsi, this groove leads downwards and inwards. The *body* or *shaft* of the humerus is thick and round above, twisted in the middle, expanded and somewhat triangular inferiorly; its posterior surface is round above and twisted a little inwards, below it looks outwards and is flat and broad; this surface is covered by and gives attachment

to the triceps muscle, a small vascular foramen may be observed about the centre; the anterior surface is divided for about one-fourth of its length by the bicipital groove into two unequal portions, the internal of which is smooth, and presents near its centre a linear elevation for the insertion of the coraco-brachialis, in the lower part of which is an oblique vascular foramen; the external portion is rough above for the insertion of the deltoid muscle, and is grooved obliquely below for the passage of the musculo-spiral nerve and artery; these surfaces are separated by two prominent lines, one is external and anterior, the other is internal and posterior, these lines are more distinct below than above, they give attachment to the intermuscular ligaments and lead down to either condyle, the external is interrupted about the middle by the musculo-spiral groove, but is very prominent below, curved forwards and gives attachment to the brachiæus anticus, the supinators and extensors, the triceps and the external intermuscular ligament; on the anterior surface of the humerus there is also a prominent line continued from the anterior edge of the bicipital groove, it is gradually flattened below and covered by the brachiæus anticus muscle. The *lower extremity* of the humerus is flattened, elongated transversely and twisted a little forwards, it presents internally the *internal condyle* which is very prominent and turned somewhat backwards, this gives attachment to the common tendon of the pronators and flexors, and to the internal lateral ligament of the elbow joint, externally is the *external condyle*, not so prominent as the internal, and situated lower down, it gives attachment to the external lateral ligament, and to the supinator and extensor muscles; between these condyles is an articulating surface turned forwards and presenting externally a *small round head* which articulates with the radius, above and internal to which is a slight depression corresponding to the margin of the radius, internal to this is a sharp semicircular ridge which separates the radius and ulna, and next to this is the *trochlea* for articulation with the ulna, this is so much below the level of the small head and of the outer portion of the articular surface, as to give the whole bone an oblique direction outwards when its lower end is placed on a horizontal plane; at the anterior extremity of this trochlea is a small depression for the reception of the coronoid process in flexion of the joint, and at the posterior is a large fossa which lodges the olecranon process in the extended state of the forearm. The humerus, like the femur, is compact in the structure of its body, and cellular in that of its extremities, it contains a large medullary canal, and is developed from eight points of ossification, one for the head, one for each tuberosity, one for the shaft, one for the trochlea, one for the small head, and one for each condyle.

The *ulna* is situated at the inner side of the forearm, it is longer than the radius, and is divided into the body and two extremities; the *upper extremity* is larger than the lower, and presents two processes and an intervening cavity; the posterior process, or the *olecranon*, is the highest part of the bone, its superior border gives attachment to the triceps extensor, posteriorly it presents a smooth triangular surface, covered by skin and by a bursa; anteriorly it is concave, and covered with cartilage; the *coronoid process* is anterior and inferior to the preceding; anteriorly it gives insertion to the brachialis anticus muscle, internally to the flexors and pronators, and to the internal lateral ligament; and externally it is hollowed out into the *lesser sigmoid cavity*, which receives the head of the radius; this cavity is oval, its greatest diameter

being from before backwards, it leads superiorly into the *great sigmoid cavity*, which moves on the trochlea of the humerus in flexion and extension of the forearm; this sigmoid cavity has a great resemblance to the letter c, if viewed in profile; it is covered with cartilage; its posterior vertical portion is larger than the anterior horizontal; it is divided by a middle ridge into two lateral portions, of which the internal is the larger; these are each again divided by a transverse furrow, which ends in a notch at either margin. The *body* of the ulna is divided into three surfaces by three lines; these surfaces are larger above than below; the anterior is slightly grooved for the flexor profundus, and presents superiorly a vascular foramen, directed obliquely upwards; the internal surface is broad and concave above, and covered by muscles, below it is round and subcutaneous; the posterior surface is irregular; it is divided into two portions by a prominent line; of these the superior and internal is broad, and gives attachment to the anconæus; the inferior and outer portion is long and narrow, and covered by the extensors of the thumb; the anterior edge is round, and gives insertion to the flexor profundus and pronator quadratus; the posterior edge is very distinct above, and gives attachment to an aponeurosis, common to the flexor profundus and flexor and extensor carpi ulnaris; the external edge is sharp for the three superior fourths, and gives attachment to the interosseous ligament. The *lower* or *carpal end* of the ulna is small and round, and presents two eminences; the external is named the *head*, it is round, and covered with cartilage, and is received into the cavity in the inner border of the radius, and is contiguous inferiorly with the fibro cartilage of the wrist; the internal eminence or the *styloid process* is more prominent, and on a level with the posterior surface of the bone; it is conical, elongated, and a little everted; it gives attachment to the internal lateral ligament of the wrist; these processes are separated posteriorly by a groove for the tendon of the extensor carpi ulnaris, and inferiorly by a depression for the insertion of the triangular fibro cartilage. The ulna is articulated above to the humerus and radius, and below to the radius and interarticular cartilage; it is developed from three points of ossification, one for the shaft, and one for each extremity.

The *radius* is shorter then the ulna by the length of the olecranon; it is situated at the outer and anterior part of the forearm, is larger below, than above, is curved about the centre, and is convex outwards; it is divided into the body and two extremities; the *upper* or *humeral end* presents a head, neck, and tubercle; the *head* is a circular superficial cavity, its surface and circumference covered with cartilage; the former to articulate with the small head of the humerus, and the latter with the sigmoid cavity of the ulna, and with the annular or coronary ligament; the internal or ulnar portion of the circumference is broader than the external; the *neck* is about an inch long, it descends obliquely outwards, it is contracted and circular; at its lower extremity is the *tubercle* this process is directed backwards and inwards, into its external rough surface the tendon of the biceps is inserted; anterior it is smooth, and covered by a bursa. The *body* or shaft of the radius is somewhat triangular, and presents three surfaces, separated by three margins or angles; the anterior surface is broad below and covered by the pronator quadratus, narrow above where it gives attachment to the flexor pollicis; about one-third from the head is the orifice of the vascular canal, slanting obliquely upwards; the posterior surface

is convex above and covered by the supinator brevis, concave in the middle for the extensors of the thumb, and convex below; the external surface is round and convex, and presents near the centre a rough surface for the insertion of the pronator teres; of the angles or edges the inner is most distinct; it is sharp, and gives attachment to the interosseous ligament. The lower or *carpal end* of the radius is square, its anterior prominent edge gives attachment to the anterior carpal ligament; posteriorly it presents three grooves for the extensor tendons; one nearly in the middle line, narrow and oblique, lodges the tendon of the extensor secundi internodii pollicis, the second is at the ulnar side of this, is broad, and transmits the tendons of the extensor communis and indicator and the third, which is to the radial side of the first, is divided into two for the tendons of the extensor carpi radialis, longus, and brevis; along the external border of these bone, is another groove leading downwards and forward and divided into two for the extensor ossis metacarpi and primi internodii pollicis; the border between these two last grooves is prolonged down into the *styloid process*, from which the external lateral ligament of the wrist arises; on the internal border is an oblong smooth cavity, to receive the lower end of the ulna; inferiorly the radius presents an articular surface, divided by a line from before backwards, into two unequal portions; the external is large and triangular, and meets the scaphoid bone; the internal is smaller, somewhat square, and meets the lunar bone. The radius, like other long bones, is of a cellular structure at each extremity, and compact in the centre, where it also contains a medullary canal, which is larger above than below; it is developed from three points of ossification, one for the shaft and one for each extremity.

The *hand* consists of the carpus, metacarpus, and fingers.

The *carpus* is composed of 8 bones, arranged in two rows; the *first row* consists of the scaphoid, lunar, cuneiform, and pisiform; the *second* of the trapezium, trapezoid, magnum, and unciform, enumerating them from the radial to the ulnar side, or from without inwards.

The *scaphoid* is the largest in the upper row, at the upper and outer side of which it is situated; it presents four articular surfaces; it is elongated and convex on the upper or radial surface, adapted to the external depression on the end of the radius; the inferior surface directed a little outwards and backwards, is triangular, smooth, and convex, to articulate with the trapezium and trapezoides; into the posterior narrow surface, ligaments are inserted; to the external or radial side, the external lateral ligament is attached; the inner or ulnar side presents two smooth articulating surfaces; one superior, narrow, to articulate with the lunar bone; the other inferior, large and concave, to articulate with the magnum.

The *semicircular* or *lunar bone* is smaller than the scaphoid; it presents four articulating surfaces; smooth and convex above to meet the radius, concave below to articulate with the magnum and unciform; its ulnar side is flat to meet the cuneiform, and its external to meet the scaphoid; its anterior surface is larger than its posterior, and it projects a litttle into the palmar arch.

The *cuneiform*, or *pyramidal bone*. The base of this wedge-shaped bone looks outwards, and articulates with the lunar, the apex inwards; it is convex and smooth above to meet the carpal fibro-cartilage; concave and smooth below to articulate with the unciform bone; rough posteriorly and internally

for ligaments; anteriorly it presents a flat circular cartilaginous surface for the pisiform bone.

The *pisiform bone.* This small pea-shaped bone is the smallest in the carpus, at the upper and inner part of which it is placed; it is also on a plane anterior to the first row; it is articulated to the cuneiform bone by a small circular surface; its circumference is rough for the attachment of ligaments; the flexor carpi ulnaris is inserted into it above, and the abductor minimi digiti below.

The *trapezium* is the most external of the second row of the carpus; it is concave above to meet the scaphoid, below it is convex from behind forwards, and concave transversely, to support the metacarpal bone of the thumb; anteriorly it is marked with a groove for the tendon of the flexor carpi radialis; internally it is articulated to the trapezoid, and beneath this by a small surface to the second metacarpal bone.

The *trapezoid* is of a very irregular shape, and smaller than the trapezium; above it is smooth and concave to meet the scaphoid, externally it articulates with the trapezium, internally with the magnum, and inferiorly with the second metacarpal bone.

The *os magnum* is the largest of the carpal bones; it presents superiorly a round and hemispherical head, which is received into the socket formed by the scaphoid and lunar bones; this head is supported by a contracted neck, its greatest convexity is turned backwards and outwards; the inferior surface of the magnum is divided into three articulating surfaces; these support the 2d, 3d, and 4th metacarpal bones; that for the 3d is the largest; its posterior surface is broad and convex below, and a little concave above; externally it joins the trapezoid, and internally the unciform; both anteriorly and posteriorly it gives attachment to the ligaments.

The *unciform bone* is next in size to the os magnum; it is situated at the lower and inner part of the carpus, is rather wedge-shaped, the base below, articulated with the 4th and 5th metacarpal bones; its upper surface is narrow, and meets the semilunar bone; its external side joins the magnum, its internal the cuneiform; its posterior surface is rough for ligaments; from its anterior projects a small hooked process, curved outwards for the attachment of the annular ligament and some of the muscles of the little finger. All the bones of the carpus, like those of the tarsus, are composed of a loose spongy vascular tissue, invested by a thin compact lamina; they are developed each from a single point of ossification, except the unciform, which has two; the pisiform is the latest to ossify.

The *metacarpal bones* belong to the class of long bones; they are 5 in number, are placed nearly parallel to each other, except the first, which is on a plane anterior to the others; the 1st is thick and short, the 3d is the longest. They are all concave on the palmar surface, convex on the dorsal, and large at each extremity; the *posterior end* is of an irregular figure; the *anterior* presents a round head; the *palmar surface* of each is narrow, and presents a median prominent line; the *posterior surface* of the 1st is convex, but on the 2d, 3d and 4th, it presents a prominent longitudinal line, which bifurcates and forms the sides of a flat triangular surface, extending for near two-thirds of their length; into their edges the interossæi muscles are inserted; the dorsal surface of the 5th is divided by an oblique line diagonally, the outer portion

is concave, and lodges the fourth interosseous muscle, the inner convex and broad, and covered by the extensor tendon of the little finger. The carpal end or base of the 1st is concave from before backwards, and convex transversely, to articulate with the trapezium; the base of the 2d is concave, and articulates with the trapezoides, and presents externally a small smooth surface for the trapezium, and internally two smooth surfaces, one for the magnum, the other for the base of the 3d metacarpal; the base of the 3d is nearly plane, and rests on the magnum, and presents on either side articulating surfaces for the contiguous metacarpal bones; the base of the 4th presents two articulating surfaces, one for the magnum and one for the unciform; on the radial side two, and on the ulnar side one articulating surface, for the adjacent metacarpal bones; the base of the 5th presents a concave surface, directed outwards to articulate with the unciform; its radial side articulates with the base of the 4th metacarpal bone. The anterior, or digital ends of all the metacarpal bones are convex, their smooth surfaces extending further on the palmar than on the dorsal surfaces of each; they are articulated with the bases of the first phalanges.

The *fingers* are composed each of three phalanges, except the thumb, which has only two; there are therefore 14 phalanges in all; the *first*, or those next the metacarpus, are the largest, the *third* are the smallest, the 2d or middle are of an intermediate size. The metacarpal, or the first phalanges are 5 in number; the base or posterior end of each presents an oval cavity for the head of the metacarpal bone; the anterior extremity of each presents two small condyles, separated by a groove; these are prolonged anteriorly, and articulate with the second or middle phalanx; the anterior surface of each is arched from before backwards, hollowed from side to side, to lodge the flexor tendon, the sheath of which is attached to its lateral edges; the posterior surface is convex and arched. The *second* or middle phalanges are 4 in number, they are smaller than the first; the base of each presents a pulley-like surface to articulate with the first, with which it forms ginglymoid joint; about the centre of their anterior surface is a rough depression for the insertion of the tendon of the flexor sublimis; the anterior or digital extremity of each resembles the anterior end of the first phalanx, and is convex from before backwards, and concave from side to side; the two articulating condyles being prolonged on the palmar further than on the dorsal surface, so as to increase the extent of flexion; the thumb wants this second phalanx. The *third* or last or *ungual phalanges* are five in number, they are the smallest, somewhat of a pyramidal form; the base articulates with the 2d phalanx, and presents a pulley-like surface, having two small cavities and a middle ridge, such as the base of the 2d phalanx; their posterior surface, convex, supports the nail, their anterior rough and irregularly concave, for the attachment of the flexor tendon and ligaments; its anterior extremity or apex is irregularly tuberculated to support the extremity of the finger. The phalanges in structure resemble metacarpal bones; the last are more cellular, and have no medullary canal; they are developed each from two points of ossification, one for the shaft, and one for the anterior extremity; the posterior end is continued from the shaft

On the articulation between the metacarpal bone and the first phalanx of the thumb there are generally two *sesamoid bones*, and sometimes one in the corresponding joint of the index finger; these bones, like those in the foot, as

well as in other situations, where they are occasionally found, as behind the condyles of the femur, in the heads of the gastrocnemii muscles, do not properly belong to the osseous system, they are rather accessories to the tendons of muscles; they are found in the limbs only, and generally in the direction of flexion; they are developed from cartilage, which is deposited in tendinous or ligamentous structure, and are very slow to ossify; the patella has some resemblance to bones of this class, it is however more perfect, and is placed on the aspect of extension; the sesamoid bones serve to strengthen the articulations to which they are attached; they also increase the power of the muscles, by altering the direction of their tendons, and removing them further from the axis of the bone which they are intended to move.

APPENDIX.

DIRECTIONS FOR OPENING THE HEAD.

The most common period of the dissection for opening the head, is, when the student has examined the attachments of the occipito-frontalis, corrugator super-cilii and temporal muscles, parts most likely to be injured in the operation: having made a transverse division of the fibres of the last named muscles, about an inch above the zygoma and any of her soft parts that may be adhering; a block should then be placed under the shoulders of the subject, which allows the head to hang down; let the student (having provided himself with a heavy hammer, strong in the claws) take hold of the head in his left hand, and with the right commence striking steadily, beginning about half an inch above the superciliary ridge, and continuing it round on a line with the incisions in the temporal muscle, terminating a little above the occipital ridge. No danger is to be apprehended of wounding the brain in this proceeding, although the student should be careful not to strike so heavily on the temporal or parietal bones as he may on the frontal or occipital, the former being of a much more brittle texture; when you have ascertained that no part of the bone remains unbroken, and have divided the pericranium with a scissors; your next step is to fix the claws of the hammer in the broken part of the frontal bone, and with a steady pull tear the skull from the dura-mater. This operation requires less labor and time than that done with a saw, and ought always to be preferred, except in cases where there is a wish to preserve the skull, or in private houses, where the feelings of the relatives are likely to be offended by the noise made with a hammer. When the saw is used, the head is to be placed on a block, the cut is to be carried round in the same direction, and the same precautions observed as described in using the hammer: if much caution be not used, the saw is very likely to lacerate the substance of the brain, owing to the inequality of thickness of the bone. In cases however where the head is to be opened for examination into the causes of death, without an intention of pursuing the dissection further, a different mode is generally practised; this is done by making an incision, by the introduction of the point of the knife under the scalp, commencing at one ear, and carried over the vertex to the other; in this way we avoid cutting the hair, which in a female might be troublesome, and the flaps made by the dissection of the scalp, being reflected over the face and neck, prevents those parts from being soiled.

OPENING THE THORAX AND ABDOMEN.

For the purpose of examining the morbid appearance after death, the cavities of the thorax and abdomen are generally opened at the same time; an

incision carried down from the top of the sternum, and ending at the symphysis pubis, dividing the integuments, muscles, and peritoneum, will bring the latter cavity into view; next let the skin and muscles covering the front of the thorax be turned back which will expose the cartilages connecting the ribs with the sternum; immediately at their point of connection with the bone, the cartilages are to be cut; in doing this some caution is to be used; if not, the viscera will sometimes be wounded by the point of the knife slipping down further than is intended; holding the knife horizontally between the thumb and the middle finger, while the fore-finger, is placed on the back of the instrument as a guide, will always obviate this inconvenience.

In some old subjects, where the cartilages of the ribs are in some degree ossified, they will not yield to the knife, and here a saw is to be employed; all the cartilages, except those of the first rib being divided, the sternum may now be raised like the lid of a box, and a very convenient hinge is made by cutting the articulation of the first joint of the sternum on the inside, directly opposite the second rib; by following this rule the figure of the thorax will be preserved, after the examination is completed, and a view sufficiently extensive for common purposes, be obtained of its contents. The practice of making a crucial incision for the purpose of examining the contents of the abdomen, should always be condemned, and should never supercede the longitudinal, as a view sufficiently extensive for every purpose is obtained by the latter; while the escape of fluids, and the unsightly appearances of the seams produced by the former method, are entirely prevented.

THE MOST COMMON MORBID APPEARANCES FOUND IN THE BRAIN.

Dura mater. The dura mater is sometimes found in a state of inflammation; to an inexperienced eye this appearance is difficult of detection, as in the inflamed state, very few vessels more appear carrying florid blood, than in the natural state; still, however, a person well acquainted with the natural appearance of the membrane, would be as much struck with the differences of its appearance when inflamed, as he would be with that of any other part of the body: in injuries from external violence, where inflammation follows, suppuration sometimes occurs, and the arachnoid coat lining the dura mater is found covered with pus, which immediately settles the question of inflammation having existed. *Scrofulous and spongy tumors* growing from the dura mater, producing absorption of the bone, or pressure on the brain, are occasionally found; another diseased appearance, although not very common, is a deposition of bony lamina in some part of the dura mater, more particularly in the falciform process or near the superior longitudinal sinus.

Tunica arachnoides. The most common and almost the only diseased structure observed in the tunica arachnoides, is an opaque or in some instances a thickened state of the membrane, which gives it a tolerable firm consistence; serous fluid sometimes of a gelatinous nature, is found between it and the pia mater; and although these appearances are said to depend on inflammation, still no vessels holding red blood are found ramifying on its surface.

Pia mater. There is much difficulty experienced in distinguishing inflammation of this membrane from its natural state; this depends on the

great number of small vessels which naturally ramify on it; however, in the inflamed state they become much more numerous, and by their anastomosis, make a beautiful reticulated appearance, not however causing such a general redness as may be observed in the inflammation of some other membranes; and when the inflammation runs high, pus is formed which is effused on the whole upper surface of the brain. Next in order to inflammation, the most common morbid appearance found in the pia mater is the formation of small cysts, containing water, which are generally called hydatids; these are found more usually on the choroid plexus, and in the velum interpositum. *Inflammation* of *the substance* of the brain is occasionally observed arising from external injury; the redness, which is generally slight, is confined to one particular part; in this state, when cut into, the color appears to arise from a great many small vessels which are filled with red blood; the inflamed part is softer and more yielding than natural, giving rise to an appearance which has been lately described by French writers and called "ramollissement;" when the inflammation proceeds further, abscesses holding pus are formed, which, if of a large size, break down the substance of the brain, and present a very jagged appearance on their internal surface. *Apoplexy*, an effusion of blood either on the surface or in the substance of the brain, is also to be met with, and occasionally into some of the ventricles, producing the disease called apoplexy; the blood found in those situations is almost always coagulated; however, when the person has long survived the apoplectic attack, the coagulated blood appears to be taken up by absorption, and its place supplied by a fluid of an albuminous nature.—*Hydrocephalus*. This is one of the most common affections of the brain; in this disease, water is found accumulated in the ventricles, amounting to a few ounces, or to so many pints; the water, by raising up the anterior part of the fornix passes from one lateral ventricle into the other, and in this manner to the third, and so on to the fourth; sometimes water is effused on the surface of the brain, but this is rare; the most common situation we find it in is between the arachnoid coat and the pia mater; sometimes effused in small patches between these two membranes, and at others over a large extent; when this effusion takes place, the vessels of the pia mater are found more distended with blood than is usual, and the arachnoid membrane is thicker and more opaque than in the natural state; in most cases where this effusion takes place, water is also secreted in the lateral ventricles, and in the sheath of the vertebral canal. *Deposition* of *bony mater* in the arteries of the brain may also be looked for; this appearance is by no means rare, particularly in old subjects: arising from this state of arteries, aneurisms of the internal carotids are described by some authors, but they are not of common occurrence.

MORBID APPEARANCES OF PARTS CONTAINED IN THE THORAX.

Pericardium. The membrane enveloping the heart is also liable to inflammation; this is not a very common disease, although it occurs sufficiently often to afford opportunities of examining its effects after death: in the inflamed state it is crowded with minute vessels carrying florid blood; it is also a little more pulpy and thicker than it is in its natural state: extravasated coagulable lymph is found loosely connecting it to the heart; this has a

reticulated appearance, and portions of it float in the serous fluid, which in this disease is found in the bag of the pericardium. In some inflammations of this membrane large quantities of pus are formed, without any appearance of ulceration, but always accompanied with a thickened state, and a deposition of coagulable lymph on the internal surface of the membrane. The presence of a small quantity of fluid in the pericardium after death, is not to be set down as a morbid appearance, or confounded with the disease called hydrops pericardii, as in every healthy body a few drachms of fluid are found in the bag of the pericardium, arising from the condensation of the natural vapor, which exists in all serous cavities, or the oozing out of the serous parts of the blood from the contraction of the heart after death.

To examine the valves of the heart, which are in many subjects ossified, the apex of that organ may be cut off, this will expose the cavities of the right and left ventricles; by introducing the fore-finger into the right, the tricuspid and semilunar valves of the pulmonary artery may be examined, while the same proceeding in the left will detect whether any disease exists in the mitral or semilunar valves of the aorta; a ligature tied tightly round the heart above the cut, will prevent any further effusion of blood.—*Polypi of the heart.* In cutting open the heart, large portions of coagulable lymph are found filling up the ventricles, and passing for some way into the large arteries; these substances were formerly considered as diseased appearances, and called polypi of the heart, but they are now more properly classed with those changes which naturally take place after death, and are accounted nothing more than a simple coagulation of blood. There are many other morbid changes that take place in the structure of this organ, such as an increased growth of the muscular fibres of the ventricle, great wasting of the parietes, deposition of fat in its substance, and some others, which a person well acquainted with the natural structure of this organ will have little difficulty in detecting.

Pleura. This membrane, when attacked by inflammation, goes through the same stages as described when speaking of inflammation of the pericardium; thickening of its substance, increased vascularity, terminating in the deposition of lymph on the surface, which has the same reticulated appearance, and in some cases going on to the formation of purulent fluid and water; where the inflammation has existed for a considerable time, an adhesion through the medium of coagulable lymph is established between the pleura costalis and pleura pulmonalis; when recent these adhesions are slight and easily broken down; but when they have existed for any considerable length of time, they become so strong that much force is required to destroy them; in fact, these adhesions are the most common morbid appearances found in the dead body. Parts of the pleura are occasionally found converted into bony plates, varying in thickness, and covering a considerable portion of the membrane; no inflammation surrounds these bony depositions, and as no spiculæ are formed on their surface which might create irritation, little inconvenience attends their growth.

Lungs. Inflammation of the lungs is almost always attended with a corresponding affection of the pleura; the inflamed portion has a darker and more florid color than natural, with an extrâvasation of coagulable lymph, and sometimes of blood, into the substance of the lungs; the weight of the part is

increased, owing to the extravasation of these fluids, and therefore it commonly sinks in water; this state, however, is to be distinguished from the accumulation of blood in the more depending parts after death, in consequence of gravitation; blood accumulated from gravitation is always of a darker color, and liable to change its position; whereas blood accumulated in an inflamed part is more florid in its appearance, and remains stationary in every position of the body.—*Abscess of the Lung.* There are two kinds of abscesses found in the lungs, one small, generally arising from the suppuration of one or more tubercles, the other, which is the common scrofulous abscess, engaging nearly the whole of the substance of the lung, they discharge themselves by ulcerated openings, generally into the trachea, or opening into the cavity of the thorax, they pour out their contents; and this is one of the causes of empyema.

Tubercles of the Lungs. There is no morbid appearance more common in the lungs than that of tubercles; they consist of round firm bodies, formed in the cellular substance, connecting the air cells of the lungs together; they are at first very small, not being larger than the heads of pins, though the ordinary size is that of a pea; when many of the smaller ones are clustered together, they probably grow into one another, and form large tubercles; they have no evident capsules, and possess little or no vascularity; when cut into, they present a white firm texture, and they often in part contain a thick curdy pus, and not unfrequently osseous matter; in cutting into the lungs, a number of abscesses are found, from many of the tubercles having advanced into a state of suppuration, it has been remarked, that tubercles have been found in the upper portion of the right lung, where there has been an impossibility of detecting them in any other part.

MORBID APPEARANCES IN THE ABDOMEN.

Peritoneum. This membrane lining the internal surface of the abdomen and investing the different viscera, although not so liable to inflammation as the pleura, yet it is not uncommonly inflamed; when inflammation is present, it appears more pulpy, than in the natural state, it is not so transparent, and is crowded with a number of small vessels, holding florid blood; where this membrane covers the intestinal canal, the inflammation appears to penetrate nearly as far as the mucous coat; sometimes the inflammation is confined to particular parts and at others it spreads over the whole membrane; when the inflammation is great the intestines become thick and massy, arising from the accumulation of fluids in the small vessels and extravasation of coagulable lymph between their tunics; this appearance may be observed in the omentum, where fluids of this nature are thrown out between its different lamina; layers of coagulable lymph gluing different portions of the abdominal viscera together, a brownish fluid, which is serum and some pus, in which shreds of coagulable lymph float, are common appearances; if the patient survive the attack of inflammation, this coagulable lymph becomes organized and the adhesions which it forms become permanent, and are to be met with in many bodies after death; an inflammation resembling the above occurs frequently in women who have been recently delivered, it is called puerperal peritonitis, the uterus is found dilated, and it is so fatal in its progress, that it seldom advances to the formation of permanent adhesions.

Peritoneal Abscess occurs in the cellular substance connecting the peritoneum to the viscera, the most common situation we find it in is between the convex surface of the liver and diaphragm; when it opens, it is by ulcerated communications with the stomach or transverse arch of the colon.

Stomach. Inflammation of the stomach is rare, except in cases of poison; when it is inflamed, the mucous membrane appears pulpy and very vascular, occasionally with some extravasation of blood between the middle and mucous coats: ulcers of the stomach are sometimes to be met with, they are unlike ulcerations in other parts; they are generally circular in their shape, with the edges smooth, defined and looking as if they were healed; the stomach is thickened in their neighborhood, although this is not always the case; an appearance that may be confounded with ulcer of the stomach is, where the gastric juice acts upon this organ after death, and produces digestion of its several coats; this latter process causes a lacerated ragged appearance of the edges, while an ulcer of the stomach looks as if a circular piece were removed by the cut of a knife.

Pylorus. The pyloric extremity of the stomach is often found much thickened; this induration is generally of a cancerous nature, it is sometimes so great, as to prevent the passage of the food into the duodenum; when it extends into the stomach this organ becomes indurated, ulceration takes place, and cancer of the stomach is then said to exist.

Intestines. The intestinal canal is very subject to inflammation, increased vascularity of the mucous coat, with thickening of all the tunics, denote this inflammation; except in violent states of inflammation, the peritoneal coat is not engaged. The color of the intestine is sometimes very dark, from a large quantity of black extravasated blood retained between its tunics; this appearance is often improperly mistaken for mortification; when the inflammation is confined to the mucous coat, it often terminates in ulceration; the ulcers which are on the mucous membrane have some difference in their appearance, sometimes having a thickened raised edge, and at others, not elevated at all above the surface; according to some, ulceration more frequently takes place in the situation of the glandulæ agminatæ; ulceration however does not appear to be so common in the small as in the great intestines; in dysenteric affections of the great intestines, a great portion of the inner membrane is found hanging in shreds, occasioned by the great ravages of the ulceration; while in some places, large patches of the mucous membrane have been totally stripped off, leaving the submucous coat quite bare, and appearing as if it had been dissected; where this unfortunately happens, the mucous membrane is never afterwards repaired.—*Liver.* The peritoneal coat covering the liver, is not uncommonly found in a state of inflammation it is either affected by itself, or is included in general peritonitis; where the former happens, the anterior or convex surfaces are generally the parts inflamed, the same appearances exist, as described when speaking of peritonitis, viz: great crowding of small vessels containing florid blood, increased thickness and pulpiness of the membrane and an effusion of coagulable lymph on the surface, which when organized forms permanent adhesions to the neighboring viscera, and are found to exist more or less in every adult dead body. When the substance of the liver is inflamed (which is a rare occurrence in these countries,) it becomes enlarged in size and of a purple color, and

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harder to the touch than in its healthy state; if the inflammation continue for any length of time, abscesses are formed, which in some cases contain many pints of pus; in persons laboring under an abscess of this kind, contracted in a warm climate, the liver will be found almost entirely converted into a bag holding nothing but pus. From the adhesions of the viscera from the previous inflammation, these abscesses generally discharge themselves by ulcerated openings into the stomach, transverse arch of the colon, or some coil of the small intestine.

Tubercles of the liver. To describe the different kinds of tubercles mentioned by authors, is not our intention, as it would only tend to embarrass the student, without being of any essential service to him, more particularly as writers themselves do not quite agree in their description of them. One of the most common diseases of the liver (if we except adhesions) is the tuberculated state of the organ; this appearance is never met with in young persons, but seems to be peculiar to the adult and aged; the whole of its substance is generally engaged, and when this is the case, the liver becomes much harder, irregular on its surface, and smaller in size than natural; dropsy of the abdomen generally accompanies this state of the organ.—*Hydatids.* There is no gland, except the kidney, in which hyatids are so frequently found as in the liver; they are contained in cysts of a cartilaginous nature, in the substance of the organ; sometimes the cyst holds but one of these animalcules, and in others it contains many varying in size from that of a pin's head to a hen's egg; rarely they are found attached to the inside of the cyst, but generally floating in the serous fluid which it contains.—*Cysts.* Cysts of a cartilaginous structure, holding earthy matter, are also found lodged in the substance of the liver.—*Gall bladder.* When the substance of the liver is inflamed, the gall bladder takes on the inflammatory process, but seldom proceeds into ulceration; the most common morbid appearance, discovered in this viscus, is the formation of gall stones: when there is but one in the gall bladder, it is generally a large oval one, closely filling up the cavity of the bag, and preventing it from receiving bile; but oftener it contains many, even amounting to some hundreds, and from rubbing on each other in a small space, they acquire many sides and angles; calculous matter as fine as powder, is also to be met with in the gall bag.—*Spleen.* The membrane covering the spleen is inflamed in general peritonitis; the appearance is the same as that which is so often described in speaking of the inflammations of other viscera; the substance of the spleen is rarely inflamed, and abscess is not common; the softness described by some authors can scarcely be considered a deviation from natural structure. The coats of the spleen are sometimes converted into cartilaginous or bony matter, and this disease may, in a great measure, be considered as peculiar to the spleen.—*Pancreas.* The pancreas is rarely found in a diseased state; calculi have been found in its ducts, it has also been seen harder in its structure than natural, approaching the nature of cancer, and one or two cases of abscess in its substance have been described. *Kidneys.* From the loose connection which the peritoneum has with the capsule of the kidney, this membrane is not so liable to be inflamed in peritonitis, as the investing membranes of other organs; the substance however, is often inflamed, and is very much disposed to form abscesses. Abscesses of the kidney are of two kinds; one, which is the scrofulous, being the most

common, containing white curdy pus, the other generally arises from the irritation produced by calculi, and bears all the appearances of phlegmonous abscess: in the first instance they destroy the mammillary portion, and if they proceed, the whole structure of the kidney is destroyed, leaving nothing but a capsule, lined with a pulpy substance, which the walls of the abscess secreted.—*Hydatids.* Hydatids are often found between the substance of the kidney and its capsule; they are not enclosed in firm cysts, nor are their coats so thick as those found in the liver; another distinction remarked is, that in the kidney they are generally all of the same size, while in the liver they vary very much, as has been already mentioned.—*Calculi.* The formation of calculi is not peculiar to the kidneys, but it is a more frequent disease in them than in any other part of the body; sometimes they are small, and are found in the tubular portion, but more commonly one calculus of considerable size is met with, lodged in the substance of the kidney or filling up the pelvis of the ureter; when it is so large as not to be capable of passing through the ureter, additional calculous matter is laid on, and in its growth it is necessarily accommodated by the parts which contain it, and becomes branched in its shape from extending into the infundibula. When a calculus in the pelvis of the kidney has increased to a large size, it almost prevents the passage of the urine into the ureter, the urine becomes accumulated above the stone, and enlarges the pelvis and infundibula. If there be obstruction to the passage of urine, from a stone being lodged in the extremity of the ureter near the bladder, not only is the pelvis of the kidney greatly enlarged, but the ureter itself partakes of the dilitation: as this process advances, the substance of the kidney becomes more and more compressed, is gradually absorbed, and nothing is left but a capsule, containing numerous cells, communicating with one another.

Bladder. The mucous membrane of the bladder is occasionally found inflamed, the inflammation may be general or confined to one particular part; the portion which is most frequently inflamed is that near the neck, and commonly arises from the presence of a rough stone: from the naturally pale appearance of the mucous membrane in the dead body, any crowding of vessels containing arterial blood which takes place in inflammation makes this state of parts easy of detection; if the inflammation be violent, the muscular coat may become engaged, and abscesses and ulcers are not unfrequently the consequence; they sometimes proceed so far as to destroy a portion of the bladder, and form communications between it and the neighboring viscera; with the rectum in the male, and vagina in the female; they have also been known to open into the cavity of the abdomen, producing peritonitis and death from extravasation of urine: abscesses about the neck of the bladder are generally found as a consequence of the operation of lithotomy being badly performed.—*Calculi.* Calculi are not uncommonly formed in the bladder; their formation is confined to no particular period of life; they are formed in very young children and persons of middle and advanced age; they are very seldom met with in females; this is owing to the size of the urethra in that sex, which allows them to be discharged before they become large, and also from a tendency to their formation not being so strong in females. The stones which are found in the bladder are either originally formed in the kidneys, and pass through the ureters into the bladder, or they are at first formed in the bladder

itself. Calculi lie either loosely in the cavity of the bladder, or are confined to some fixed situation from particular circumstances; when they are of a small size, they are sometimes lodged in pouches, formed by the protrusion of the mucous coat of the bladder, between the fasciculi of its muscular fibres. Urinary calculi have sometimes a smooth, uniform surface, but more frequently the surface is granulated and rough.—*Prostate Gland.* This gland is scarcely ever found diseased except in old men; it is rarely inflamed, an abscess however has been met with (unaccompanied by any thickening) in its substance, arising from common inflammation. *Scirrhus.* The most common disease of the prostate gland is scirrhus; the gland in its natural state is known to be about the size of a chestnut, but when it is affected with scirrhus, it is often enlarged to the size of the fist. The common appearances observed in scirrhus in other parts of the body, can be plainly seen in this gland; when cut into, it appears to consist of a very solid, whitish, or brown substance, with membranous septa, running through it in various directions. According to the degree of enlargement that takes place, the urine is passed through the bladder with greater or less difficulty, as well as an instrument for drawing it off. *Calculi* have been found lodged in the ducts of the prostate gland; they are usually small granules of a dark color, and give it a mottled appearance when cut into.

Uterus. When the uterus becomes inflamed, it takes place almost under the same circumstances, viz. very soon after parturition. When it is inflamed the peritonæum in the neighborhood is most commonly affected, and frequently over its whole extent. The uterus, when inflamed, exhibits the same appearances as the inflammation of the substance of other parts; the inflammation is found to creep along the appendages of the uterus, especially the Fallopian tubes and ovaries. It often advances to suppuration, and the pus is generally found in the large veins of the womb. When the peritonæum is affected by the inflammation, it has been remarked, that the extravasated fluid and coagulable lymph are found in a greater proportion to the degree of inflammation, than in common peritonitis.—*Polypus.* Polypi are very frequently found in the uterus; they may grow at any period of life, but they are rarely met with in the young. By a polypus is meant a diseased mass, which adheres to the cavity of the uterus, by a sort of neck or narrower portion. Polypus is of two different kinds; the most common kind is hard, and consists of a substance divided by thick membranous septa; this sort of polypus varies very much in its size, some not being larger than a walnut, and others being larger than a child's head. Another sort of polypus forms in the uterus, which consists of an irregular bloody substance, with tattered processes hanging from it; when cut into it appears to be a spongy mass, holding large cells. The most common part to which polypi adhere, is the fundus uteri, and sometimes they are found attached to the os tincæ.—*Ovaria.* The membrane covering or the substance of the ovaria, are very rarely found inflamed, except when they are included in general peritonitis; when the inflammation proceeds from the uterus, it sometimes goes on to the formation of pus in the ovary.—*Dropsy.* The most common disease in the ovary is dropsy, the whole substance of the ovarium is sometimes converted into a capsule containing fluid. When the ovaria have become dropsical, their natural structure has disappeared,

and they are found converted into cells, communicating with one another by considerable openings, and very much enlarged: the ovaria are sometimes converted into a series of cysts, which have no communication with each other; these cysts have been confounded with hydatids, to which they bear some resemblance; they are, however, very different; they have much firmer and less pulpy coats than hydatids, they contain a different kind of fluid, and they are differently connected among themselves. Hydatids either lie unconnected, or one large one encloses a number of small ones; while ovarian cysts adhere to each other by broad surfaces, and do not enclose each other. The ovaria are sometimes found converted into cysts, holding large masses of fat, hair, and some teeth; these substances appear to be generated by the internal membrane of the cyst; the hairs are most of them loose in the fatty substance, but many of them adhere to the inside of the capsule; the teeth, which are not always perfect, are sometimes attached to the cyst, and at others, to an irregular mass of bone.

LAENNEC'S DIVISION OF THE REGIONS OF THE THORAX.

The chest of a healthy person, when slightly struck, ought to yield over its whole extent a clear and distinct sound. The character of the sound derived from percussion, is different in the different parts of the chest; on which account it has been divided by Laennec into fifteen regions, twelve of which are double.

1. *Subclavian region.* This includes merely that portion of the chest covered by the clavicle. When struck about the middle or external extremity, this bone yields a clear sound, but its humeral extremity gives rather a dull sound: a knowledge of the morbid or natural sounds of the chest in this region, is of great importance; for from it are usually derived the first signs of the development of tubercles in the lungs, which are found in the upper part of the right lung, even where they exist in no other part of the chest.

2. *Anterior superior region.* This is bounded by the clavicle and by the fourth rib (inclusive) below. The sound, though clear, is somewhat less so than over the sternal end of the clavicle.

3. *Mammary region.* This begins below the fourth rib, and terminates with the eighth. In the female, the mammary gland, in the male, the inferior edge of the pectoralis major prevents this region from yielding as good a sound as the anterior superior region.

4. *Submammary region.* This extends from the eighth to the cartilaginous border of the false ribs. On the right side the sound is often dull, caused by the size of the liver; while on the left, the sound is frequently more clear than natural, which is attributed to the presence of the stomach distended with gas.

Sternal regions, 5 superior; 6 middle; and 7 inferior. The sound is as clear over the whole extent of the sternum, as on the sternal end of the clavicle. However, the inferior region sometimes yields a duller sound, in consequence of the accumulation of fat about the heart.

8. *Axillary region.* This extends from the axilla to the fourth rib inclusive: the sound here is naturally clear.

9. *Lateral region.* This is bounded by the fourth rib above, and terminates

with the eighth. The sound is always good on the left side; on the right it is altered frequently by the liver rising higher than usual, and compressing the right lung.

10. *Inferior lateral region.* This is bounded above by the eighth rib, and terminates at the border of the false ribs. This region also, on account of the liver, yields often a completely dull sound on the right side, while on the contrary the left, for reasons before mentioned, gives a clearer sound than natural, even where there be effusion of fluid into the pleura, or where the inferior portion of the left lung be obstructed.

11. *Acromial region.* This is comprehended between the clavicle, the upper edge of the trapezius, the head of the humerus, and the lower part of the neck. The soft parts interposed in this place prevent all sound from percussion.

12. *Upper scapular region.* This corresponds to the supra-spinous fossa of the scapula, and yields hardly any sound on account of the muscle which fills it. The spine of the scapula, which forms the inferior boundary of this region, sometimes yields a faint sound when the arms are strongly compressed across.

13. *Lower scapular region.* This corresponds to the infra-spinous portion of the scapula. It yields no sound on percussion because this portion of the clavicle is covered by the infra-spinous muscle.

14. *Inter-scapular region.* This includes the space between the dorsal edge of the scapula and the spine, when the arms are crossed on the breast. The muscles of this region necessarily render every sound dull; sometimes, however, in thin persons, it gives a low but distinct sound, if the head be bent and the arms crossed in order to make tense the trapezius and rhomboidei muscles. The spine in this region gives a good sound; as likewise that portion of the chest included between the superior dorsal angle of the scapula and the first dorsal vertebra.

15. *Inferior dorsal region.* This begins at the level of the inferior angle of the scapula, terminating at the twelfth dorsal vertebra. Percussion of this region should be made in a transverse direction, on the angle of the ribs; in the upper part, the sound is sufficiently good; in the lower it is slight, or often does not exist, especially on the right side, from the presence of the liver; on the left side it frequently gives an unnaturally clear sound, on account of the distended state of the stomach.

A CONCISE VIEW OF THE LIGAMENTS AND MUSCLES CONCERNED IN SIMPLE DISLOCATIONS.

A SIMPLE dislocation is the separation of the articulatory surfaces of a joint accompanied by rupture of ligaments, but without fracture; by which the motions of the joint are impeded or suspended. The action of muscles with respect to luxations is of two kinds; one, in producing dislocation; the other, in resisting reduction. The first is a simple contraction of the muscle by which dislocation is produced when the articulating surfaces are placed in a position mechanically favoring this accident. The second is that slow contraction of the muscle, (called tonic,) which invariably takes place when the points of its attachment are approximated. Examples of both kinds are best

illustrated by dislocations of the shoulder joint. When the arm is raised from the body violent action of the pectoralis major, latissimus dorsi and teres major muscles, may pull the head of the bone down into the axilla; and when this displacement has occured, the contraction of the pectoral and other muscles still going on, though more slowly, will bring the head of the bone forwards towards the sternum and clavicle; and present a strong obstacle to reduction.

OF DISLOCATION OF THE HEAD FROM THE FIRST CERVICAL VERTEBRA.

A DISLOCATION of the head from the first cervical vertebra has only been found in consequence of disease. The displacement may occur, either forwards, backwards, or to either side, compressing powerfully the spinal marrow. These kind of dislocations taking place from internal causes are not in any degree affected by the neighboring muscles; but the anterior and posterior ligaments, with the odontoid, must be injured in any displacement forwards or backwards. It is to be remarked that dislocation of the dentata, or of one or more of the cervical vertebræ, always accompany this displacement of the atlas

OF DISLOCATION OF THE ATLAS FROM THE AXIS.

THE first cervicial vertebra may be dislocated from the second; first, directly backwards, with the laceration of the transverse, and odontoid ligaments; and of the apparatus ligamentosus colli. The inter-transverse muscle is also torn.

2nd, By a violent rotation of the head, the lateral portions of the transverse ligament, and the odontoid being ruptured, the dentata may slip back under the transverse ligament, and thus be dislocated.

3rd, By a fracture of the processes dentatus. This may take place when violence is applied in such a direction that the ligaments attached to the processus dentatus are powerfully extended, by which this process is broken off. Simple dislocation of the atlas from the axis has hithereto been considered the only one which can take place in the cervical region. Between the occipital bone and first cervicial vertebra it cannot happen from external force; because, though there are no strong connecting ligaments, the articulatory surfaces are too closely joined, and the movements between them too slight and limited. Besides, the rotary motion of the head, in which alone this accident could occur, is strictly confined to the atlas and axis. Obstacles still more powerful oppose a dislocation of the other cervical vertebræ. The oblique direction of the articulatory surfaces, by which rotation is prevented; the peculiar mode in which the bodies of these vertebræ are articulated; not with a smooth surface, as in the dorsal, but with a depression on the superior surface, from which two hooklike processes ascend and embrace the body of the vertebra above it: the inter-spinous and inter-transverse muscles, which exist in this part of the spine only; the strength of the inter-vertebral substance, which being of less depth here will not readily yield: and above all, the limitation to motion, partly produced by the mechanical forms of the bones, partly by the mode of action of the muscles: these circumstances concur to render a dislocation of one

cervical vertebra from another, without fracture, extremely difficult. In fact it has hitherto been considered, by the greater number of writers, as an accident which could not occur; but an example of simple dislocation forwards of the fourth from the fifth cervical vertebra was lately seen in St. Bartholomew's Hospital; and a similar accident occured still more lately in this country.

OF DISLOCATION OF THE LOWER JAW.

The structure of the articulation of the lower jaw renders it impossible for any other than the forward dislocation to take place. This most readily happens when the mouth is opened widely, or when any violence is used which tends to depress the lower jaw. In such case, the condyle being brought forwards to the anterior edge of the articular eminence, if the pterygoideus externus and anterior portion of the masseter act strongly, the condyle slips forwards under the zygoma, and the dislocation is produced. Usually the internal lateral ligament alone is ruptured, unless the displacement has been occasioned by some sudden violence. The muscles which depress the lower jaw, and thus assist in producing luxation, are the platisma myoides, the digastric; the mylo-hyoideus; the genio-hyoideus, and the genoi-hyo-glossus. Both condyles may be dislocated at the same time; or one separately. The first is called complete dislocation; the latter, a partial dislocation; but this nomenclature is to be condemned as leading to confusion of the terms. When dislocation of both condyles has taken place the mouth remains permanently open, in consequence of the coronoid process resting on the angle between the malar and maxillary bones. The line of the lower arch of the teeth, instead of falling behind the upper, as in the natural position, falls before them: there is a depression in front of the ear, where the condyle of the lower jaw should be felt, and the muscles of the side of the face appear flat and diminished. When displacement of one condyle only occurs, the arches of the teeth of the upper and lower jaws do not correspond; and the depression in front of the ear is only felt on the dislocated side The muscles concerned in a dislocation of the lower jaw are the depressing muscles of the jaw; the two pterygoid muscles, but chiefly the external; and the anterior portion of the masseter.

OF DISLOCATION OF THE CLAVICLE.

At its sternal end the clavicle may be dislocated upwards, forwards or backwards. Displacement upwards or backwards are too rare to merit any notice. In dislocation forwards the anterior, posterior, and inter-clavicular ligaments are ruptured; and occasionally the tendinous expansion of the sterno-cleido-mastoid on the clavicle and sternum. The costo-clavicular ligament must also be ruptured; and this is the one which chiefly resists displacement when the shoulder is elevated. At its scapular extremity, the clavicle may be displaced either above or below the acromion; the latter case is extremely rare. When the clavicle passes above the acromion, the shoulder inclines in, being unsupported by this bone, and its extremity projects under the skin of the shoulder. The superior, inferior, and coraco-clavicular ligaments are sometimes ruptured. The clavicular, portion of the trapezius is the only muscle which by elevating the clavicle, can assist in this displacement.

OF DISLOCATION OF THE HUMERUS.

The shoulder joint, from the great extent of its motions and forms of its articulating surfaces, is more liable to dislocation than any other in the body.

Primary dislocations of the humerus may occur, into the axilla, forwards under the pectoral muscles, or backwards. This latter species is extremely rare; a dislocation upwards could not occur without fracture of the acromion. and therefore cannot be considered among simple dislocations. A primary dislocation, either directly backwards or directly forwards, is not likely to happen, as the strong attachments of the teres minor, supra and infra-spinati muscles to the greater tubercle of the humerus, and that of the sub-scapular to the lesser tubercles, respectively offer powerful resistance in either of these directions. It is plain then from the constructions of this joint, that a dislocation downwards, where the head of the bone rests on the sternal costa of the scapula, between the subscapularis and long head of the triceps, is the most likely to occur; for the lower part of the capsular ligament being unsupported by muscles, is most weak; and the action of the levator muscles of the shoulder, by rotating the head of the humerus from above down, will bring the head of the bone near the inferior edge of the glenoid cavity and thus place it in a situation most favorable for displacement, when violence is applied to the extended arm. There is but one circumstance in the construction of the joint which has a tendency to counteract the accident, which is, that the glenoid cavity is of greater extent from above down than across.

DISLOCATION DOWNWARDS.

When the humerus is dislocated downwards, the head of the bone is found resting on the sternal costa of the scapula, between the long head of the triceps and sub-scapularis. The lower portion of the capsular ligament is ruptured, and sometimes the tendon of the sub-scapularis; the tendons of the supra and infra-spinati muscles and of the teres minor are also sometimes lacerated. The anatomy of the sound joint would lead us to conclude that these latter muscles should be injured much more frequently than the former, but dissections of dislocated shoulder-joints have proved the contrary. Some of the fibres of the deltoid, pectoralis major, and coraco-brachialis are occasionally torn; the long tendon of the biceps usually remains unbroken. Independent of external violence, the elevating muscles of the humerus, and of the whole arm, (if the elbow joint be fixed,) with the pectoralis major, latissimus dorsi and teres major may, under certain circumstances, effect this displacement of the bone. The deltoid and supra-spinatus muscles are those which most powerfully resist reduction.

DISLOCATION FORWARDS.

When the head of the humerus is thrown forwards, it lies on the inner side of the neck of the scapula, between it and the second and third ribs. The internal portion of the capsular ligament and the tendon of the subscapularis

are ruptured ; though examples have occured in which the luxation has taken place without laceration of the tendons of any of the muscles surrounding the joint. As has been already mentioned, the action of the muscles, attached to the greater tubercle of the humerus, counteracts forces tending to produce this species of displacement.

DISLOCATION BACKWARDS.

Dislocation backwards under the spine of scapula is extremely rare ; it does not present any thing worthy of particular remark. In a case mentioned by Delpech, the head of the bone lay in immediate contact with the scapula, under the infra-spinatus muscle.

OF DISLOCATION OF THE ELBOW-JOINT.

A dislocation of the elbow-joint most frequently takes place by a luxation backwards of both radius and ulna. The accident is sometimes complicated with a fracture of the coronoid process of the ulna. It is facilitated by the relation of the articulating surfaces in the semi-flexed position of the arm ; when, if external violence be applied, the coronoid process slips behind the internal articular pulley of the humerus and is lodged in the sigmoid fossa, while the humerus is thrown forwards on the radius and ulna. The external, internal, and sometimes the annular ligament of the radius are ruptured, though the accident may occur without injury to any of these parts ; occasionally the biceps and brachialis internus suffer from the violent projection of the humerus. The brachial artery also has been ruptured in this manner. The flexor muscles of the arm, by keeping it bent, and the triceps by its contraction, are the muscles which oppose reduction. The internal condyle of the humerus and the olecranon present two prominent points, which are of great importance in assisting us to detect injuries about the elbow-joint. In the extended position of the arm they are nearly on the same line, and any displacement of the bones will cause a corresponding displacement of these two prominences.

The form of the bones, the strength of the lateral ligaments, and the numerous muscles surrounding the joint, prevent a complete lateral luxation of both ulna and radius, while a luxation forwards cannot occur without fracture of the olecranon.

OF DISLOCATIONS OF THE HUMERAL EXTREMITY OF THE RADIUS.

The radius may be dislocated at the humeral extremity, either backwards or forwards. When the radius is driven through the back part of the capsular ligament it is found to rest above the external condyle of the humerus, supported by the brachial fascia. The accessory and annular ligaments are torn, and sometimes the interosseous ligament suffers at its superior part.

In dislocation forwards of the radius, the head of the bone rests above the external condyle of the os humeri. The accessory and annular ligaments, with a portion of the interosseous ligament, are ruptured in this luxation as in the former. The biceps muscle becomes shorter by contraction, and thus may resist, though not in any great degree, reduction.

OF DISLOCATION OF THE HUMERAL EXTREMITY OF THE ULNA.

The ulna may be dislocated backwards on the os humeri without being accompanied by the radius. The coronoid process is forced over the pulley of the humerus into the sigmoid fossa, and the olecranon forms a prominent projection at the back part. The annular and accessory ligaments are ruptured, and sometimes a small portion of the interosseous. The action of the triceps will contribute to keep the bone in this position, while on the contrary, the brachialis internus assists in the reduction.

OF DISLOCATIONS OF THE JOINT OF THE WRIST

The wrist joint may be dislocated either by the radius and ulna being both thrown forwards, or both backwards. Lateral dislocations are always partial. As these displacements always occur by falls on the ground, or other violence, by which the hand is forcibly bent on the bones of the fore-arm, extensive laceration of the capsular, anterior, or posterior ligaments, must accompany them. The tendons also of the flexor and extensor muscles are more or less displaced, and some of them may be ruptured. The form of the arch of the first range of metacarpal bones favors the dislocation backwards, since from their greater convexity in this direction, they do not afford as much support to the bones of the fore-arm.

OF DISLOCATION OF THE CARPAL EXTREMITY OF THE RADIUS.

The carpal extremity of the radius may be dislocated either forwards or backwards; the first of these accidents is much the more frequent. The bone is thrown forwards on the scaphoid and os trapezium. The capsular and anterior ligaments alone are ruptured. If the head of the radius be thrown back from its articulating surfaces, the back part of the capsule, the posterior, and sometimes the external lateral ligament are ruptured. The bone projects under the skin at the back of the wrist.

Separate dislocation of the carpal extremity of the ulna takes place either forwards or backwards. The only circumstance worthy of notice is the difficulty of keeping the bone in its place, in consequence of the rupture of the sacciform ligament.

The close connection of the bones of the carpus, and the numerous ligaments spread in all directions over the back and front of the hand, present powerful obstacles to complete dislocations of any of these bones: in fact, surgeons of the greatest experience have never met with such an accident. The only part of the articulation at which it is likely to occur, is where the head of the os magnum is received into the depression of the semi-lunar and scaphoid bones, because here the quantity of motion is greatest; however it is almost invariably incomplete.

OF DISLOCATIONS OF THE THUMB.

The first metacarpal bone may be dislocated from its articulation with the trapezium forwards or backwards; in the backward luxation the carpal

extremity of the bone is driven through the posterior part of the capsular ligament. It does not appear necessary that the lateral ligaments should be ruptured. The flexor ossis metacarpi, and flexor brevis and longus, with the abductor, offer great resistance to reduction when delayed for any time.

In dislocation forwards the metacarpal bone is thrown between the trapezium and the root of the second metacarpal bone. The thumb is bent back, and cannot be flexed. The external lateral ligament is in this case more likely to be torn than in the former. The extensors of the thumb are the muscles which offer resistance to reduction of this dislocation.

OF DISLOCATION OF THE FIRST PHALANX OF THE THUMB.

The first phalanx of the thumb is frequently dislocated backwards, from the head of the metacarpal bone. The lateral ligaments remain uninjured. This dislocation is interesting from the great difficulty of reducing it when neglected even for a short time. The phalanges of the other fingers may be dislocated either backwards or forwards, but present nothing worthy of attention.

OF DISLOCATION OF THE HIP JOINT.

The joint of the hip may be dislocated in four ways, backwards and upwards on the dorsum of the ilium, backwards on the ischiatic notch, forwards and upwards on the pubes, and forwards and downwards on the foramen obturatorium.

The hip joint is not at all so liable to dislocation as that of the shoulder; for this several reasons may be assigned. In the first place, its motions are much more limited both in number and extent. The glenoid cavity affords little mechanical security, while the cotyloid on the contrary permits the head of the femur to sink into it. The oblique direction also of the head of the thigh bone presents an additional obstacle; the capsular ligament of this joint is much stronger than that of the shoulder, and it is further protected by strong accessory fibres on the outer and upper part, which descend from the inferior anterior spine of the ilium, and by some on the inner side from the superior part of the foramen ovale. The articulation of the hip is also more closely invested by muscles; above we have the gluteus minimus and tendon of the psoas and iliacus muscles. In front the rectus; on the inside, the pectinalis and obturator externus; and behind, the quadratus femoris, gemini, pyriformis, and obturator internus. The situation of the trochanter major is a point of great importance in discriminating accident about the hip joint, and its relation to some other prominent points should be well kept in mind. In the erect position of the body, the superior part of the trochanter major is nearly on the same level with the body of the pubes. The distance between the anterior superior spine of the ilium and the trochanter major is less than from this projection to the os pubis, or from the os pubis to the anterior superior spine; and lines connecting these three points will form nearly a right angled triangle, of which the longest side is the line connecting the superior spine to the pubis; and the shortest, that which joins the spine to the trochanter. In dislocation upwards or backwards the trochanter is brought nearer the superior

anterior spine of the ileum. In the backward luxation it is removed from the body of the pubis, and is not as prominent as in the natural state. In the dislocation into the obturator foramen, the distance between the trochanter major and the body of the pubis is lessened; while that between this process and the anterior superior spine is greater than usual.

In dislocation upwards and backwards the head of the bone rests on the dorsum of the ileum. The upper part of the capsular ligament is ruptured; and the external accessory and round ligaments are torn. In rotation inwards the head of the femur is pressed against the back part of the capsular ligament, and if the rotation be carried far, a considerable portion of the bone is outside the cotyloid cavity: hence the species of dislocation now described is most likely to occur when rotation inwards is accompanied by external violence.

When dislocation has occured the three glutæi muscles are those principally concerned in keeping the head of the bone fixed on the dorsum of the ileum; but when the head of the bone is sufficiently raised to pass over the edge of the acetabulum, the psoas and iliacus with the obturator externus and pectinalis, will assist to bring it into the proper situation. Although in common cases of dislocation no other injury is done to the joint than what has been already described, the dissection of a luxation upwards and backwards has been published, in which the gemini, pyriformis, obturators, and quadratus femoris, were completely torn across, with laceration of some fibres of the pectinalis.

In the dislocation backwards on the ischiatic notch the head of the bone rests on the pyriformis muscle. This dislocation also is most likely to happen when the thigh is rotated inwards and bent towards the abdomen. The pyriformis, gemini, and obturator internus muscles keep the bone in the dislocated position; while the psoas, iliacus and obturator externus favor reduction. When the femur is dislocated forwards on the obturator foramen, the capsular ligament and the internal accessory fibres are lacerated. The ligamentum teres is not always ruptured. The pectinæus and adductor brevis (if not lacerated, which often takes place) will keep the bone in its new situation; while the glutæi and all the muscles arising behind the acetabulum will contribute to bring it back to its proper place. In dislocation upwards and forwards the head of the bone rests on the ramus of the pubes under Poupart's ligament, where it may be plainly felt. The gemini, obturator internus, and pyriformis if not ruptured) would favor reduction. A calculation has been made, that out of twenty dislocations of the hip joint, twelve will take place on the dorsum ilii; five on the ischiatic notch; two on the foramen ovale; and one on the pubes.

OF DISLOCATION OF THE JOINT OF THE KNEE.

Dislocation of the patella may take place either upwards, inwards, or outwards: the latter is the more frequent form: a dislocation upwards could not occur without rupture of the inferior ligament of the patella, which is so strong that frequently in violent action of the extensor muscles, the patella itself snaps across before this ligament gives way. When the knee is much bent dislocation in either direction cannot take place. The extent of the articulating surfaces of the femur, and the force with which the patella is pressed in between the condyles prevents such an accident. The position

most favorable to this luxation is where the knee is slightly bent and inclined inwards. When complete luxation of the patella outwards has taken place, the patella rests over the external condyle of the femur, in which place it is fixed by the rectus, crureus, and vasti muscles: hence, the necessity for bending the thigh on the pelvis, in order to relax these muscles as much as possible. The extent of the synovial membrane permits this displacement to occur without any rupture. Dislocation of the patella inwards is so similar in its nature to the outward luxation that it does not require any notice.

The tibia may be dislocated from the femur, backwards, forwards, or to either side. Of these the only one likely to be complete is the backward: lateral luxations are always partial. There is no joint in the body so well supported by ligaments as that of the knee; on the sides we have the lateral ligaments; in front the ligament of the patella and the tendinous insertion of the extensor muscles; behind the posterior ligament of Winslow; and more particularly the strong crucial ligaments. Additional ligamentous bands are also occasionally seen. When the tibia is completely dislocated backwards, into the ham, the ligamentous attachments of the patella either above or below must give way. The crucial and posterior ligaments are also torn. The flexor muscles of the leg, which are attached to the tibia, will contribute to keep the bone in the luxated position. Complete forward dislocations of the tibia have occurred, but they are very rare. In such case all the ligaments of the joint must give way, and the heads of the gastrocnemii and popliteus muscles would also probably suffer.

OF DISLOCATION OF THE UPPER HEAD OF THE FIBULA.

Luxation of the upper head of the fibula is usually the consequence of disease; for the application of a force sufficient to dislocate the bone is much more likely to break it. The action of the biceps flexor, the only muscle inserted into the fibula, could not alone produce this accident. When the head of the fibula is thrown back, the anterior ligament and the accessory fibres from the tendon of the biceps, with the synovial capsule, are ruptured. Boyer mentions a case in which the whole fibula was driven directly upwards in consequence of a dislocation outwards of the ankle.

OF DISLOCATION OF THE TARSAL EXTREMITY OF THE TIBIA.

The tibia may be dislocated at its tarsal extremity, backwards, forwards, or to either side. Luxation inwards is the most common. These accidents can be produced by external violence alone. When the tibia is luxated inwards it is found resting on the inner side of the astragalus and os calcis. The fibula is broken usually at its lower third, and the broken end of this bone is situated on the astragalus. The synovial membrane is ruptured with laceration of the deltoid and anterior ligaments of the tibia, and of the posterior transverse band from the tibia to the fibula. After the accident has taken place, contraction of the gastrocnemii, solei, and peronæi muscles, by rotating the foot out and drawing it upwards, will offer resistance to reduction. If the tibia be dislocated outwards, the malleolus internus must be broken off; the deltoid ligament is not ruptured; but if the fibula be not broken, the

external lateral, anterior and posterior ligaments of this bone are lacerated. In the forward dislocation, the fibula and usually the malleolus internus are broken. The tibia rests on the os naviculare and internal cuneiform bone. The posterior part of the deltoid ligament, and the transverse band from the tibia to the fibula are ruptured. Dislocation forwards is an accident of rare occurrence. It cannot happen when the foot is flexed on the tibia, for then the tibia sinks down on the back part of the astragalus, and nothing but considerable force could raise it over the upper portion of the bone, which, in this position, extends like a bridge before it.

Luxation backwards is even still more rare. Were such an accident to take place all the tibial ligaments would be broken, and the fibula most probably fractured.

The astragalus, the os cuneiform internum, and the range of tarsal bones articulated with the os calcis and astragalus, are sometimes dislocated simply, but the accident is of very rare occurrence. Dislocations of the phalanges of the toes are similar to those already described as taking place in the fingers, and do not deserve particular notice.

DIRECTIONS FOR MAKING DRIED PREPARATIONS OF ARTERIES.

Although in every anatomical school competent persons are retained for the purpose of injecting arteries and veins; still the student may wish to do it for himself, or he may be placed in such situations that he cannot command any kind of assistance; to him, more particularly, the few remarks which we purpose making on the method of injecting and of preserving arterial preparations, may be considered applicable.

Injections are of two kinds, coarse and fine; there are many descriptions of coarse injections; with the fine we have nothing to do, as it is used by anatomists only for the purpose of imitating the natural vascularity which membranes and other structures lose after death. Coarse injections may be employed either hot or cold, formerly the hot injection was the only one used, but now the cold one is very frequently employed. As much of the success of the injection depends on the state of the subject, great care should be observed in the choice; if possible a young and thin one should always be employed, as the arteries in old subjects are so often ossified and inelastic, that we can never be certain that they will not burst from the force employed, and extravasate the injection between the muscles and into the different cavities; another objection to the use of old subjects is, that the constant oozing of oily matter from preparations made of them renders them filthy, and almost useless, particularly in warm weather; however, some old subjects may be filled with the cold (or paint) injection, if care be taken not to use too much force. When the student has made up his mind to employ the hot injection, it may be useful to him to follow a few rules. In the first place the pipe should be tied so firmly in the opening into the vessel, that there will be no possibility of its slipping out; secondly, the nozzle of the syringe should always be introduced into the pipe, for the purpose of exhausting the artery of air or coagulated blood; this being done the stopcock should be immediately turned; and lastly, particular care should be taken that the syringe, pipe, and stopcock are free and in good order.

To inject with the hot injection, it is necessary that tne subject should be thoroughly heated; this is best done by opening the cavities of the thorax and abdomen, and filling them with water of a temperature that the hand can bear; the body at the same time should be immersed in water of the same temperature, taking care to exclude atmospheric air as much as possible. The process of heating should be carried on until the subject has acquired a temperature resembling the natural heat of the living body. While this is going on, the injection should be particularly attended to, as the materials are very inflammable, and if care be not taken, or much heat be employed, there will be danger of burning the chimney or house; heat slowly applied will melt the injection without any admixture of air, or endangering the loss of color, which strong heat would certainly effect. When the subject and injection are sufficiently heated, the injection should be sucked up twice or thrice, so as to mix it well with the coloring matter, which always falls to the bottom; before the syringe is introduced into the pipe, it should be held up and the piston pressed till the injection appears, by which any air that may be in the syringe will be permitted to escape; taking the wings of the pipe in the left hand, the syringe is to be introduced, and the piston is to be pushed down slowly and gradually with the right hand, until the syringe is emptied; this action is to be repeated, till we feel resistance made to the further passage of the fluid in the arteries; if after this resistance is felt, any further force be used, there will be great danger of rupturing the arteries and producing extravasation. As soon as we are satisfied that the body is injected, it should be put in cold water, where it should remain for a few hours. Either of the following hot injections may be used:

Wax ℥xvi.
Resin ℥viii.
Turpentine Varnish ℥viii.
Chinese Vermilion ℥i.

This makes a very handsome injection, but it is liable to the inconvenience of melting in warm weather, and in this way producing a flattened appearance in the blood vessels. A much cheaper and better injection for common purposes than the above has been employed; it is made of

Tallow 2lbs.
Magnesia Usta ℥ss.
Chinese Vermilion ℥i.

This possesses all the advantages of the wax injection without any of its inconveniences; it is as transparent nearly as the wax, never melts in the hottest weather, and is not disposed to crack; if this injection be used very hot, an extremity may be injected without having been previously heated; but this should never be done except by persons skilled in the art of injecting.

If we wish to trace the minute branches of arteries, and examine their various communications, there are no injections better adapted for common purposes than that of tallow and red lead well mixed and heated, or the *cold paint injection;* if the latter be well thrown in, the minutest arteries, for instance the ciliary, will be injected; it is made of

White lead, well ground, 2lbs.
Turpentine Varnish ℥xii.
Drying Oil ℥vi.

The lead is intimately mixed with the varnish, and then the oil is to be added; they are all to be well mixed up together, to the consistence of cream, and in this state it is to be thrown into the arteries; the same precautions, with regard to the exclusion of air from the syringe, and the degree of force to be used, are to be observed in this as well as in the hot injection. Arteries are always injected from the aorta or some other large trunk; while veins are injected differently; in making preparations of veins, it is necessary to inject them from the extreme branches towards the trunks, on account of the direction of the valves; for instance, the veins of the arm are to be injected from a small branch on the back of the hand, and those of the leg and thigh from some branch on the dorsum of the foot. Previously to the injection being made, it is necessary that the veins should be well washed out with warm water, to remove the coagula of blood which they generally contain; if the veins of the arm are to be injected, an opening should be made in the subclavian vein, to allow the warm water and coagula to pass out: when this has happened, a ligature previously applied is to be firmly tied round the vessel, which will prevent the injection from flowing out; the same rule applies to the injection of veins in the lower extremity. The veins of the head and neck are generally injected from the superior longitudinal sinus: it is scarcely necessary to mention that veins are filled with blue fluid, and the arteries with white or red; for the blue injection smalt blue is usually employed. To inject the arteries a transverse cut is to be made in the aorta, as close to its origin from the heart as possible. Care must be taken that the extremity of the pipe does not project so far as to pass into the innominata, or one of the vessels arising from the left side of the arch, as this would give only a partial injection. The nozzle of the pipe being carefully inserted into the opening of the vessel, two pieces of twine are to be introduced under the vessel; one of these is to be firmly tied round the artery, this will embrace the nozzle of the pipe, its loose extremities, when the knot is firmly tied, are to be fixed to the wings of the pipe in order to prevent any chance of its slipping out of the vessel. The other ligature is to remain loose under the vessel, beyond the nozzle of the pipe about one inch. After injection is thrown in, this ligature is also to be firmly tied round the vessel, leaving the pipe clear; the use of it is, that the injection may not return back when the pipe is removed from the aorta. This precaution is more particularly necessary when the paint injection is used. In inserting a pipe into a small artery or vein, some difficulty may arise in the introduction from the pipe being larger than the calibre of the vessel; in this case the point of a scissors should be introduced into the vessel, and gradual dilatation produced by slowly opening its blades. When the injection has remained sufficiently long to set well in the vessels, dissection may be commenced, and here it is a rule which should be invariably followed, that the dissection be completed in as short a time as is consistent with a proper display of the vessels, for many preparations are lost in consequence of the part first dissected becoming spoiled before the remainder is prepared for drying. Particular care should be taken to remove all the cellular substance from the coats of the vessels; if this be not done, the preparation will always have a dirty appearance. The fatty matter is likewise to be removed, but no muscle is to be taken away or pushed from its situation unless perfectly unavoidable. The student should always remember that the utility of a dried

preparation consists in its preserving, as far as possible, the natural relation of parts ; on this account, the use of pieces of stick or other substances to separate the muscles and exhibit the course of the vessels, unless absolutely necessary, is to be condemned. One side of the subject ought to be appropriated to the exhibition of the superficial vessels, the other may be used for the deep seated. When the dissection is completed, the extremity, or whatever portion of the body it may be, should be hung up in a dry and airy situation (but not exposed to the sun) until the muscles acquire firmness, and no exudation appears on their surface. The preparation now fit for use, is to be brushed over with copal or mastich varnish, which makes the vessels more distinct, and materially assists in its future preservation.

THE END.